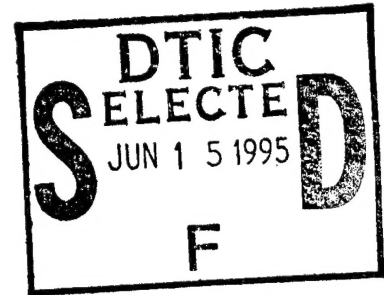




**Remote Tracking Antenna Study
(TAGGANT)**

**Scientific and Technical Report
(Final Report)**

Contract #DAAL02-91-C-0091
CDRL Item #A004



31 December 1992

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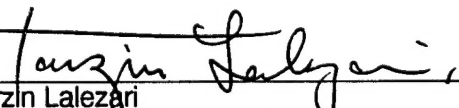
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INTRODUCTION

The final report includes the progress report for the months of October, November and December 1992. The main emphasis remained on packaging and improving the RF performance of an antenna/receiver for Satcom. Additionally, many other type of antennas were investigated. The following antennas were investigated and their data will be discussed in turn (note these are not in chronological order):

1. Letter decal antennas
2. Argos 90 degree bowtie antenna
3. Cellular bow tie antenna
4. Cellular bent monopole antenna
5. Antenna below variable aperture

1.0 LETTER DECAL ANTENNAS

A few letters were chosen at random to determine the feasibility of making antennas look like car window decals which actually operate at cellular telephone frequencies. The data in Appendix I looks promising although we simply did not have enough time to fully investigate this.

The three letters we chose were U, W, and N as shown at full scale in **Figure 1**. The VSWR's, antenna patterns and swept gains are shown in Appendix I. Although we chose the letters at random, the letter "L" would have been an important choice as it contains both vertical and horizontal components. Those other letters are somewhat directive (or directional) and have much better polarization isolation than expected. Also, note that this data was taken without the presence of ground planes. The remaining task is to pick a location on an automobile and a decal logo (LSU for example). It is also necessary to engineer ways to hide the feed and optimize the antenna pattern.

2.0 ARGOS 90 DEGREE BOWTIE ANTENNA

The Argos application requires an omnidirectional coverage for both polarizations at 401 MHz. Based on experience a 90° bowtie dipole antenna was chosen because of its simplicity and



low profile. Bowtie dipoles with a wide subtended result in both components of polarization. However, as the data in Appendix II shows, the polarization isolation is greater than desired. The full scale photocopy of the artwork of this bowtie antenna is shown in **Figure 2**.

There are two possible solutions to this issue. First of all the angle could be increased to greater than 90° . This would probably produce the desired effects with the exception of the nulls off the ends of the dipole for one polarization. The second option is to use printed cross dipoles which would solve the polarization issue but would still have nulls for one polarization off the ends of the dipoles of the opposite polarization.

3.0 CELLULAR BOWTIE ANTENNA

This antenna is a scaled version of the Argos antenna and is shown in **Figure 3**. The center frequency for this antenna is 880 MHz. The data is presented in Appendix III. Results are similar to the Argos antenna. A completely different approach is available as discussed in the following section.

4.0 CELLULAR BENT MONOPOLE ANTENNA

This antenna is shown in **Figure 4**. It is relatively low profile and requires only a small ground plane. The coverage of this antenna is very good in one hemisphere as shown in Appendix IV. The best orientation of this antenna is for the circuit board material to be horizontal. This will provide good hemispherical coverage and could be mounted on a car top or in a briefcase or suitcase.

The data shown in Appendix IV is for the antenna sketched in **Figure 4** without any additional ground plane. Also, note that this is a variation of the antenna that BCSD is mass producing for the commercial cellular telephone market.

5.0 ANTENNA BELOW VARIABLE APERTURE

In the Satcom band, we were directed (by HDL) to determine the effect of an aperture of variable size on an antenna of known performance. An Archimedean spiral (11 x 15 inch) was chosen as the candidate and tested in the presence of a variable size aperture. The data are presented in Appendix V. The following cases were tested.



Antenna Size	Aperture Size	Depth of Antenna Below GP
11" x 15"	12 x 16 (1" border)	1/8" and 1/2"
11" x 15"	13 x 17 (2" border)	1/8" and 1/2"
11" x 15"	14 x 18 (3" border)	1/8" and 1/2"
11" x 15"	16 x 20 (5" border)	1/8" and 1/2"

As can be seen from this table, for each aperture size the depth of the antenna below this aperture in the 4 ft x 4ft square ground plane was variable between eighth inch and half inch. The results of this test show that the depth below the aperture in the ground plane had little effect compared to the size of the aperture. The larger the aperture the less it disturbed the patterns and gains. The patterns of the antenna without the presence of any aperture are also included in Appendix V.

The gains of the antenna in the presence of the aperture are 2 dB lower for the 1-inch border case and about 0.5 dB lower (as compared to no aperture) for the 5 inch border case. Thus the size of the aperture has a relatively large effect on the performance. The data shows that the depth of the antenna below the aperture has only a minor effect.

6.0 REVIEW

This program began with BCSD (per HDL direction) focusing on GPS and cellular telephone antennas to be located beneath a vehicle or in a non-metallic bumper. Standard BCSD GPS antennas were tested at both GPS and GLONASS frequencies with good results (see Appendix I of the October 1991 progress report for complete data). Also bent monopole cellular antennas were built and tested. This included a single element as well a four elements and three element arrays (Appendix II of the October, 1991 progress report and Appendix I November, 1991 progress report respectively). Although suitable GPS and cellular antennas were designed, data on a vehicle was not ever taken as the focus of the program changed.

The focus of this program was shifted to designing and packaging antennas (in particular Satcom antennas) into a portable case. There were a considerable number of configurations built and tested before the final silhouette design evolved (see Appendices I-V of this report). Also, S-band Bifilar and Quadrafilar Helices were investigated for communicating with TDRSS



(Tracking and Data Relay Satellite System). This data is in Appendices 7 and 8 of the October 15, 1992 progress report. Additionally as described in this report, cellular telephone letter decal antennas development began with promising results. Wide angle bowtie dipoles for Argos (401 MHz) and cellular were also built and tested. Finally, to simulate a rooftop application, tests were performed with variable apertures and depths. These results are in Appendix V of this report, although it was determined that the larger the aperture the better the results.

The antennas that BCSD will deliver with this program are as follows:

Item	Quantity	Description
1	3	Letter Decal Antennas (Letters, U, W, and N)
2	1	Argos 90 degree Bowtie Antenna
3	1	Cellular 90 degree Bowtie Antenna
4	1	Cellular Bent Monopole Antenna
5	1	Bifilar Helix Antenna for TDRSS

Overall this program was quite successful. First of all, the development of Satcom portable antenna and case evolved extremely well. Secondly, a good solid base of data has been taken from which further development may be guided by. For instance, the letter decal antennas are a very promising ones to explore further. Also, adding other functions to the portable silhouette case is another possibility. Additionally, adding other antennas and receivers to other cases is realizable, BCSD looks forward to continuing development in these areas in the near future.

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By <i>per Arg. ltr.</i>	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

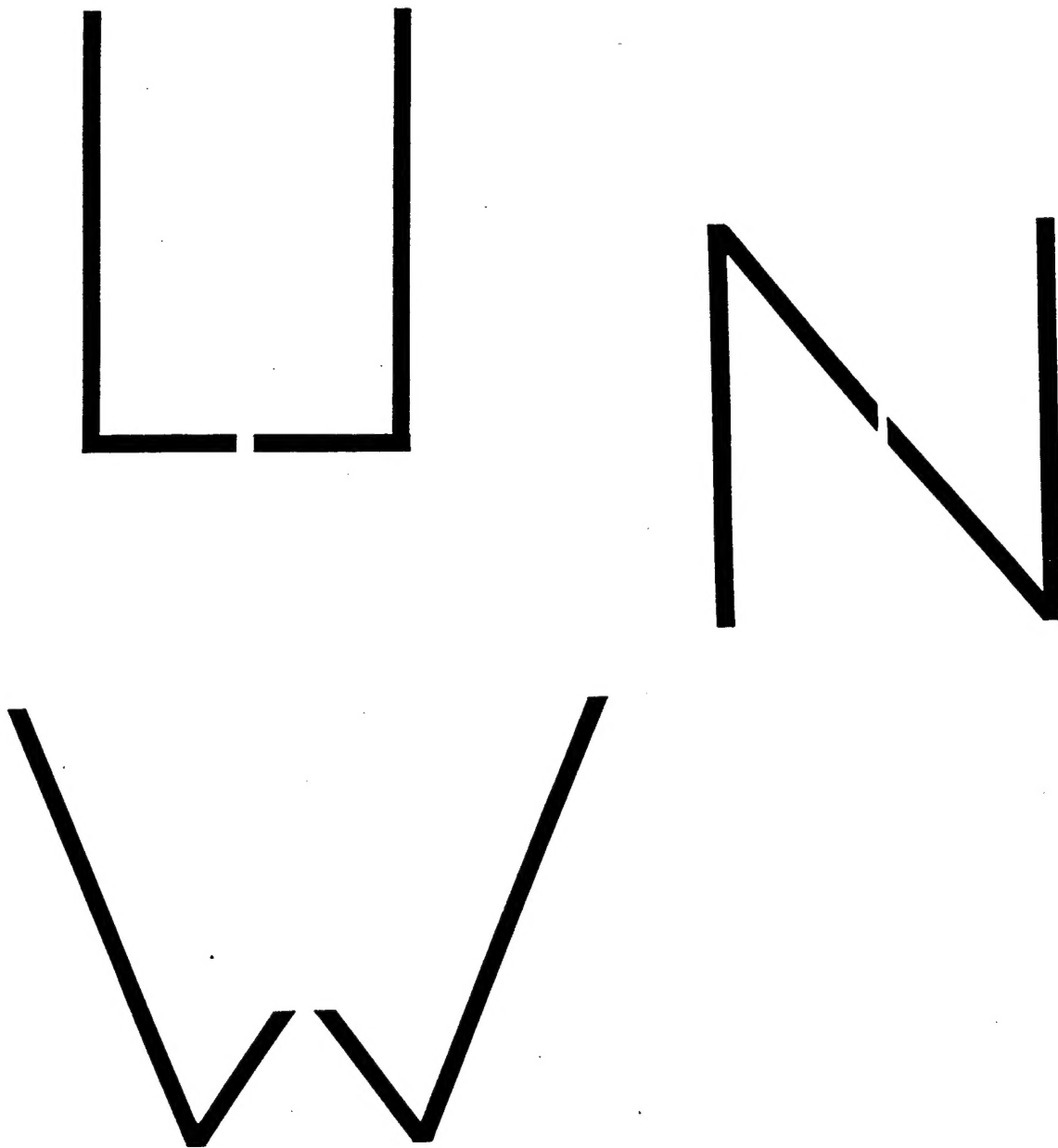


Figure 1. Letter Decal Antennas for Cellular Telephone (U, W, N)

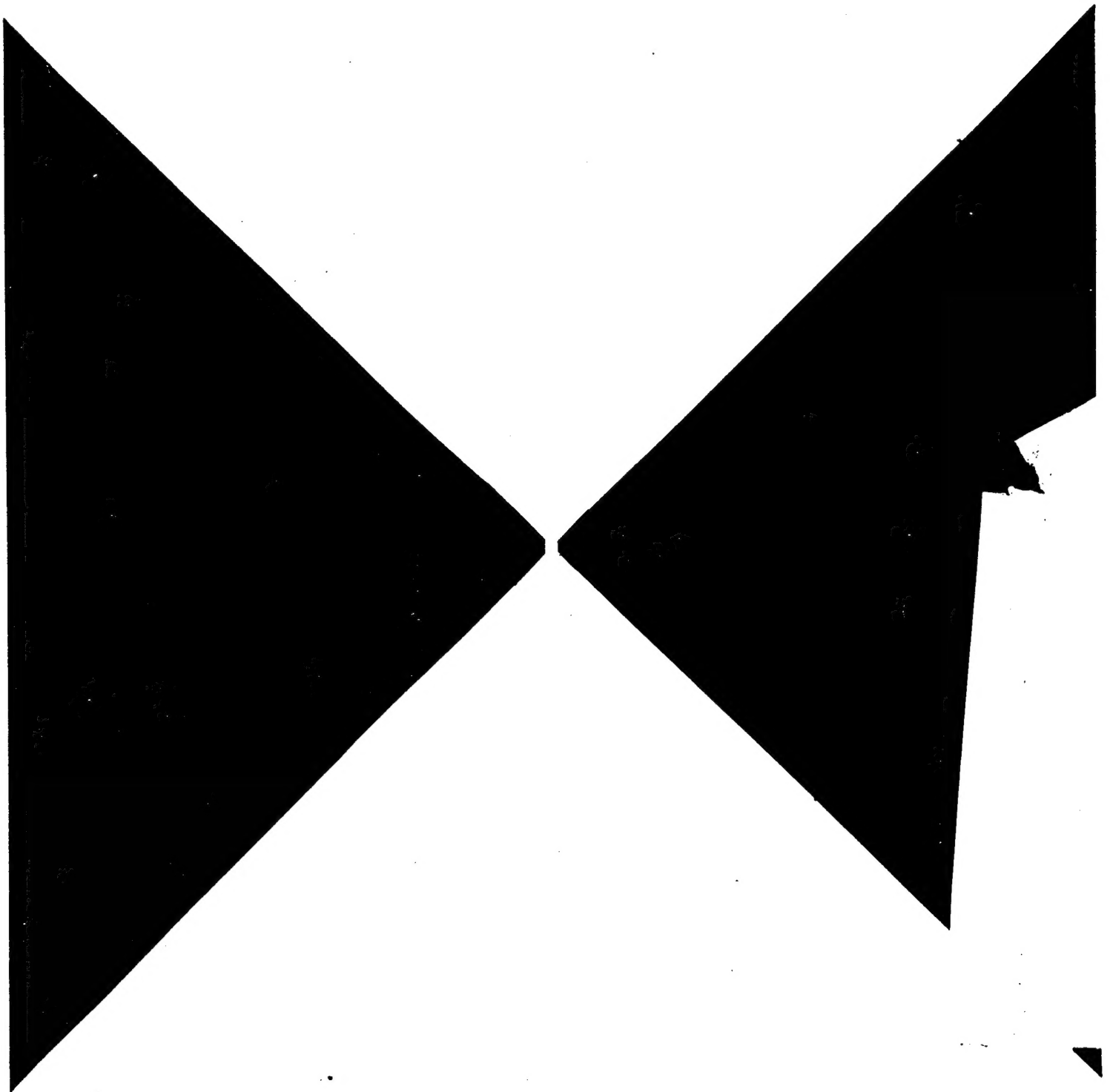


Figure 2. Argos 90° Bowtie Dipole Antenna (401 MHz)

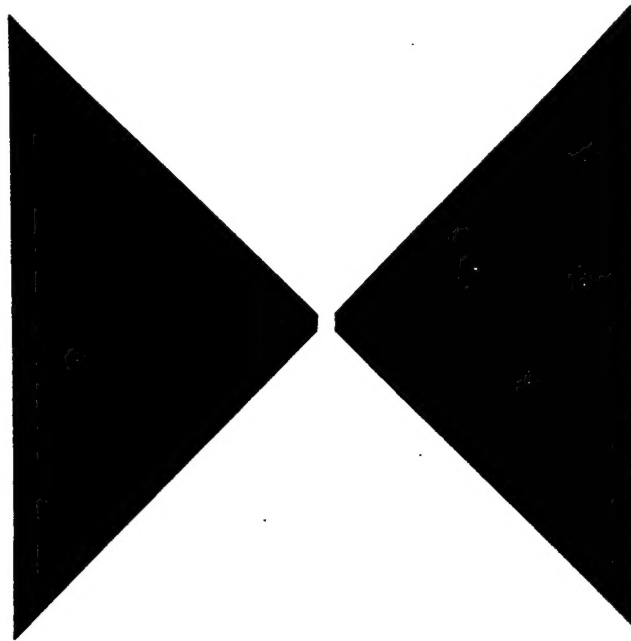


Figure 3. Cellular 90° Bowtie Antenna



Cellular Bent Monopole
Copper Monopole = 0.035 Thick
Board Material = 0.060 in.

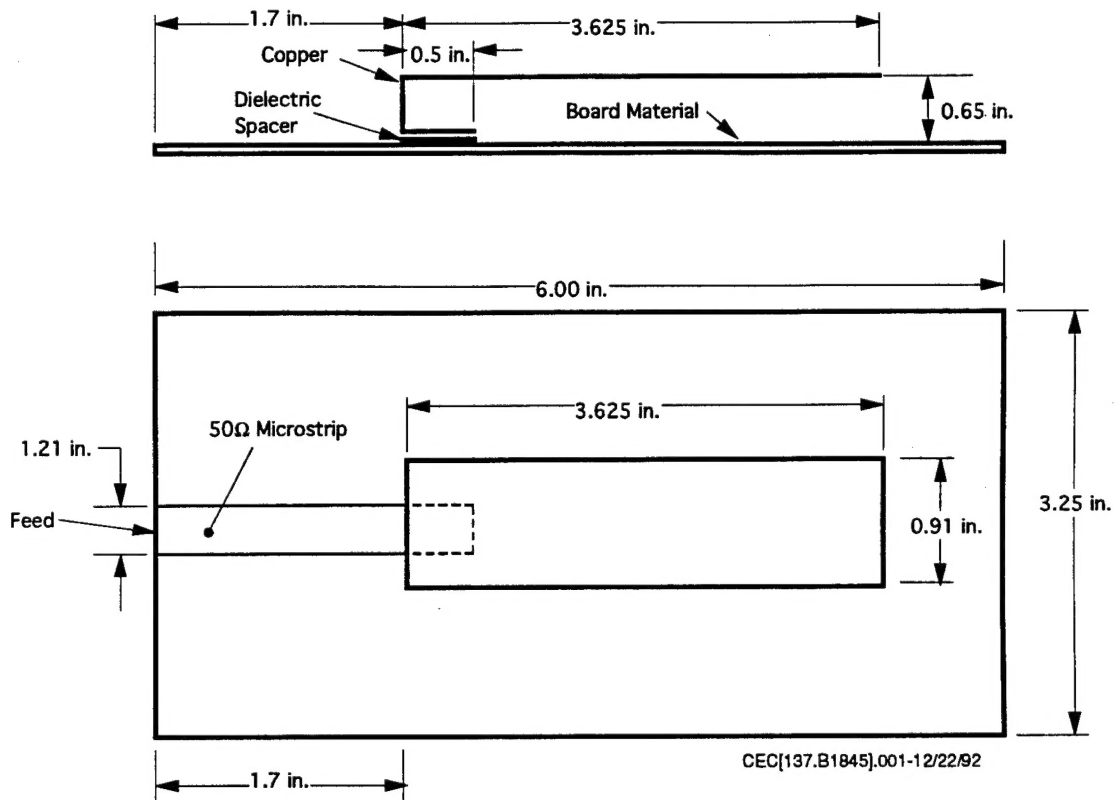


Figure 4. Cellular Bent Monopole Antenna

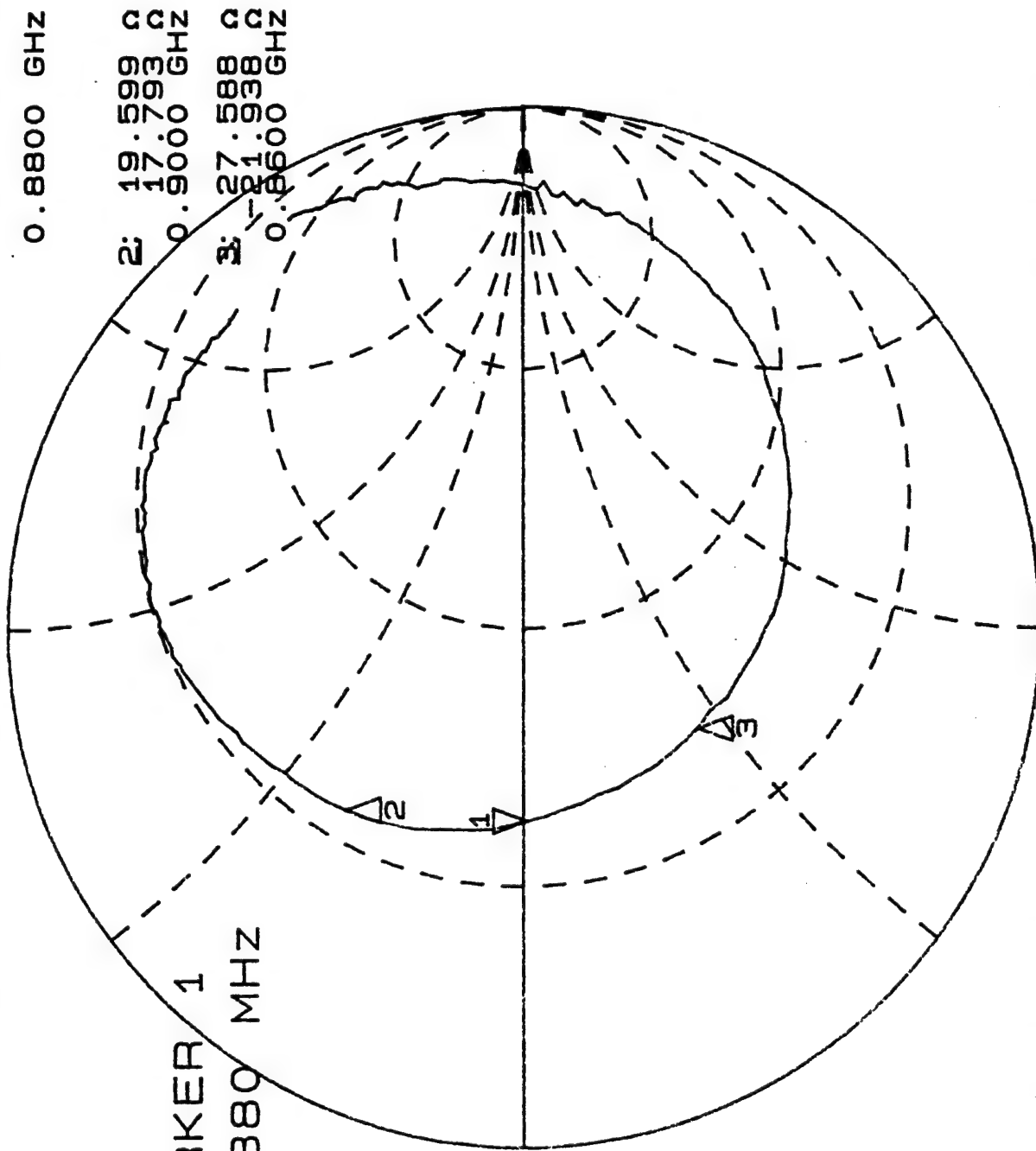


Appendix I

Letter Decal Antennas

CH1 S22 1 U FS 1: 22.958 Ω -413.09 m Ω 437.82 pF 12-17-92
 02 0.8800 GHz Letter U

Cor MARKER 1
 Del 880 MHz

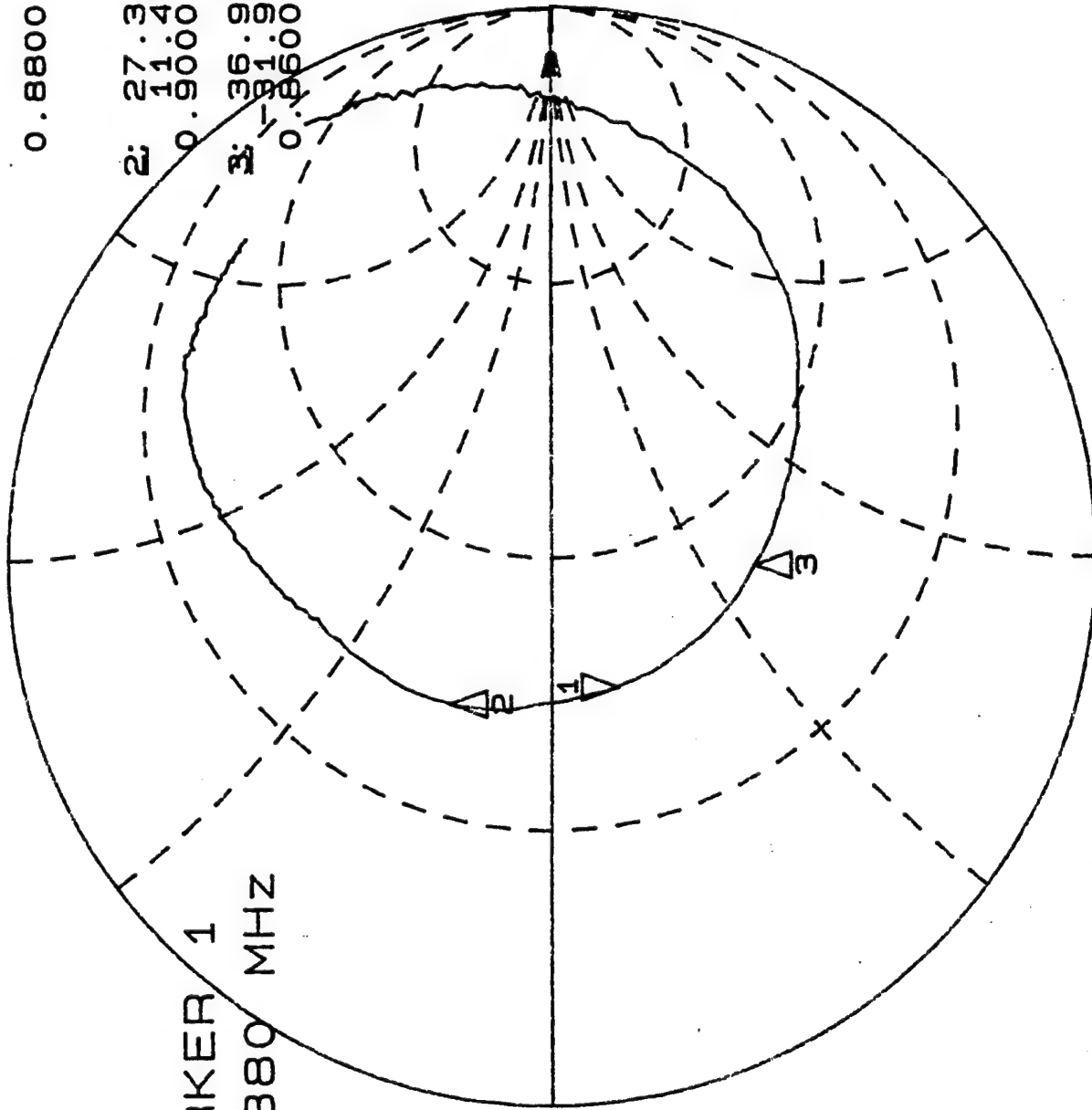


CENTER 0.8800 GHz SPAN 0.4000 GHz

CH1 S22 1 U FS 1: 30.159 Ω -7.9189 Ω 22.839 pF 12-17-92
 0.8800 GHZ Letter N

Cor MARKER 1
 Del 880 MHZ

2: 27.353 Ω
 11.407 Ω
 0.9000 GHZ
 3: 36.98 Ω
 31.973 Ω
 0.8600 GHZ



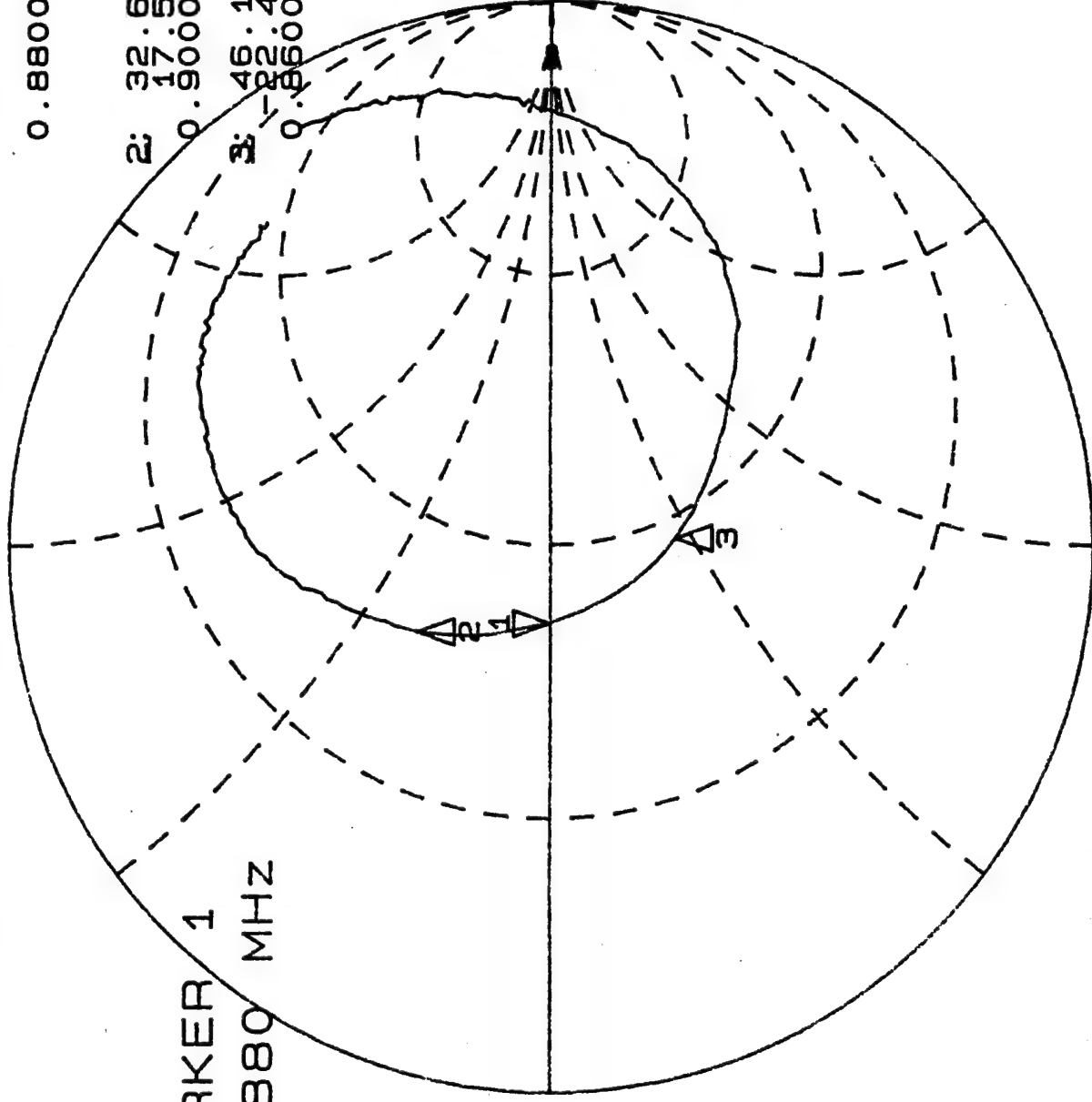
CENTER 0.8800 GHZ SPAN 0.4000 GHZ

0.8800 GHz

Col Del

MARKER/1

880 / ZHN



CENTER 0.8800 GHZ

SPAN 0.4000 GHZ

Letter W
12-17-92

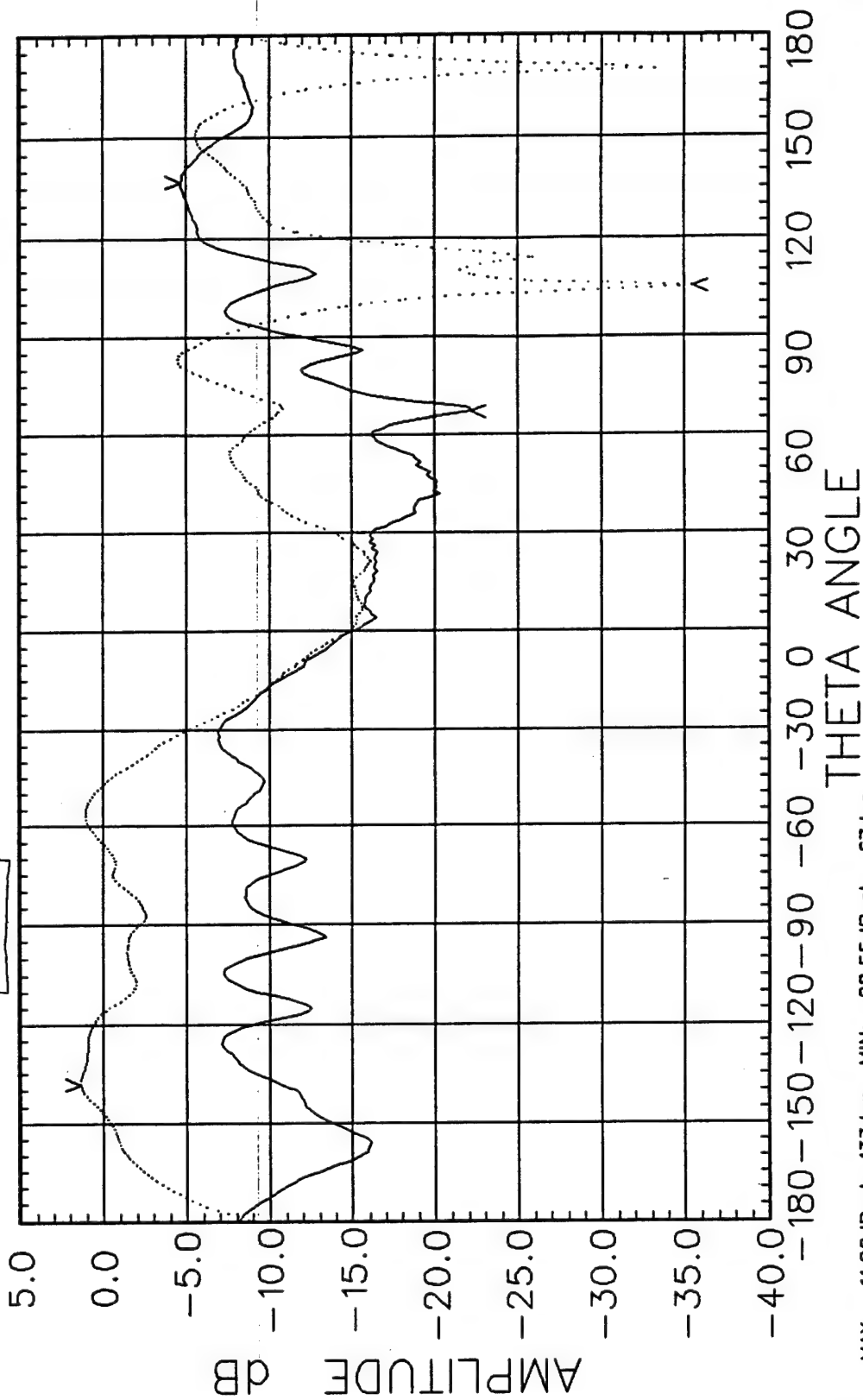
ELEVATION
17 DEC 92

860MHz A-AMPLITUDE PHI=
860MHz A-AMPLITUDE PHI=

TAGGANT BENT MONOPOL

BALL AEROSPACE

0deg NORMALIZED BY 6.35dB DF1341 HAS 0dB IF ATTEN SOURCE= 90deg → H
0deg NORMALIZED BY 5.84dB DF1351 HAS 0dB IF ATTEN SOURCE= 0deg → V



— MAX: -11.02dB at 137deg MIN: -28.55dB at 67deg
..... MAX: -4.47dB at -138deg MIN: -41.35dB at 105deg

1) RFL01-19 MAY 92
2) RFL01-19 MAY 92

ELEVATION
17 DEC 92

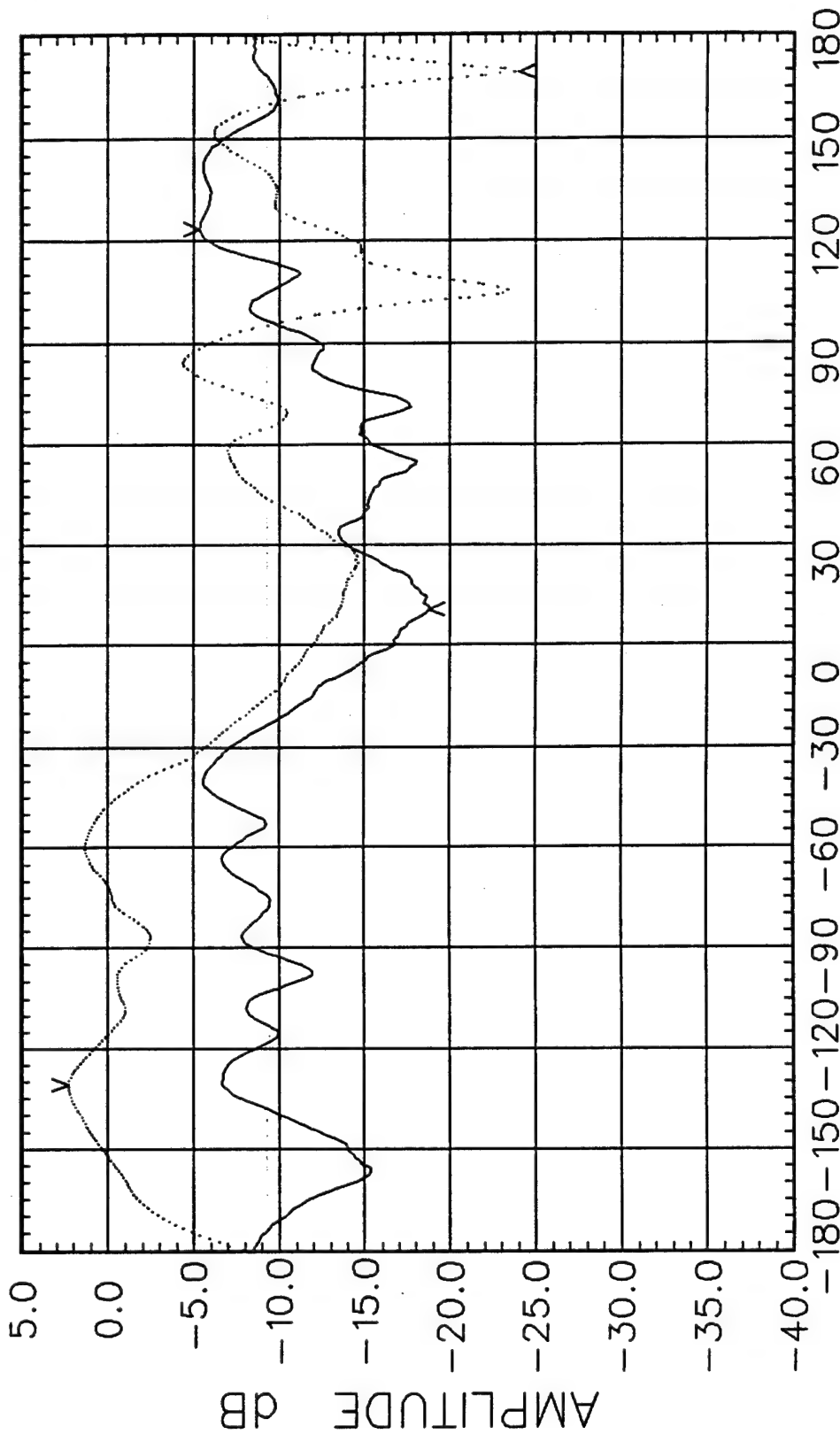
— is 880MHz A-AMPLITUDE PHI=
... is 880MHz A-AMPLITUDE PHI=

0deg NORMALIZED BY 5.26dB DF1342 HAS
0deg NORMALIZED BY 4.80dB DF1352 HAS

0dB IF ATTEN SOURCE= 90deg
0dB IF ATTEN SOURCE= 0deg

BALL AEROSPACE

TAGGANT BENT MONOPOL



— MAX: -10.57dB at 123deg MIN: -24.01dB at 10deg
... MAX: -2.50dB at -131deg MIN: -28.86dB at 169deg

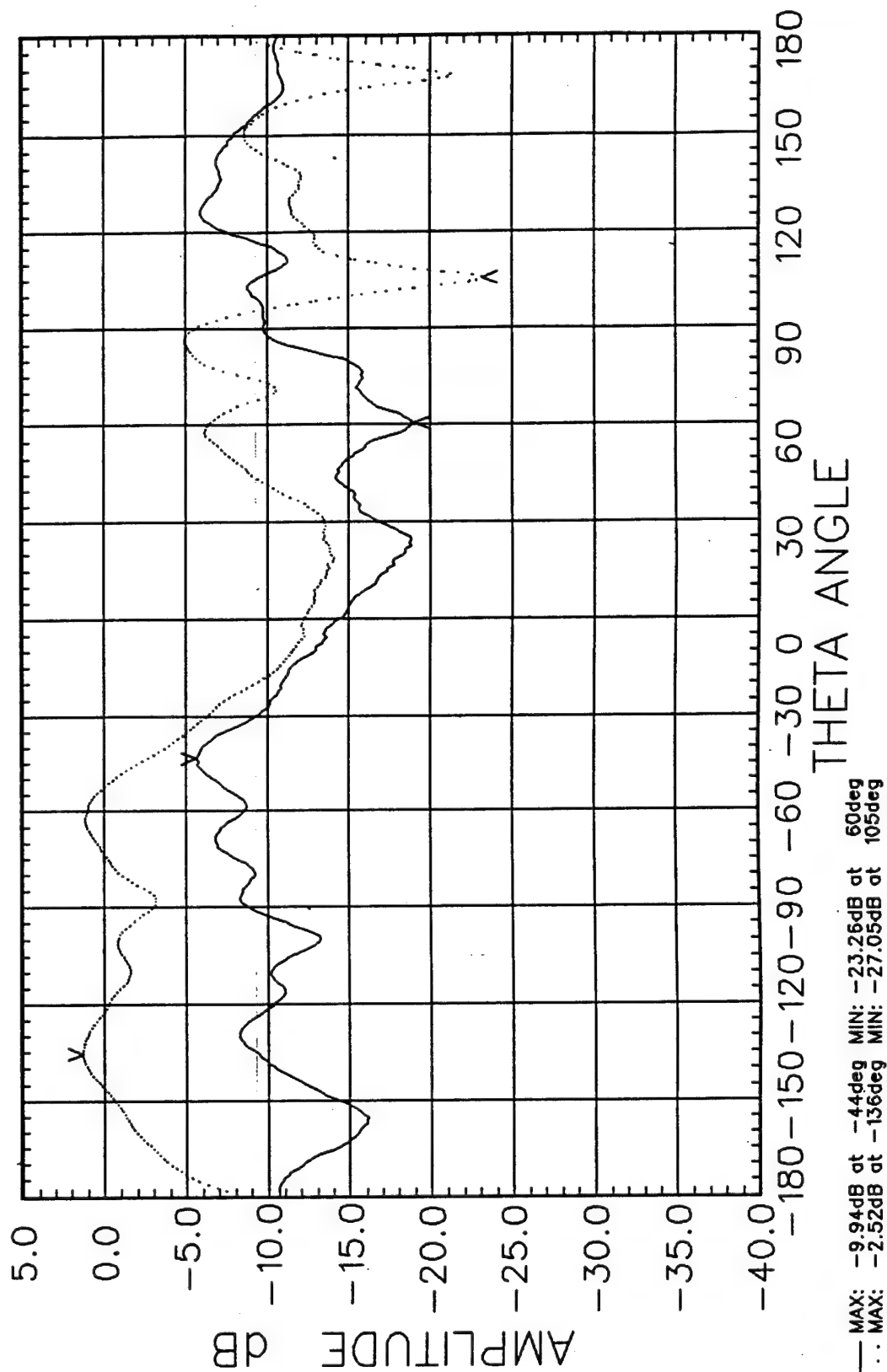
2) RFL01:19 MAY 92
1) RFL01:19 MAY 92

ELEVATION
17 DEC 92

BALL AEROSPACE

TAGGANT BENT MONOPOL

900MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 4.27dB DF1343 HAS 0dB IF ATTEN SOURCE= 90deg H
900MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 3.84dB DF1353 HAS 0dB IF ATTEN SOURCE= 0deg V



2) RPLDT:19 MAY 92

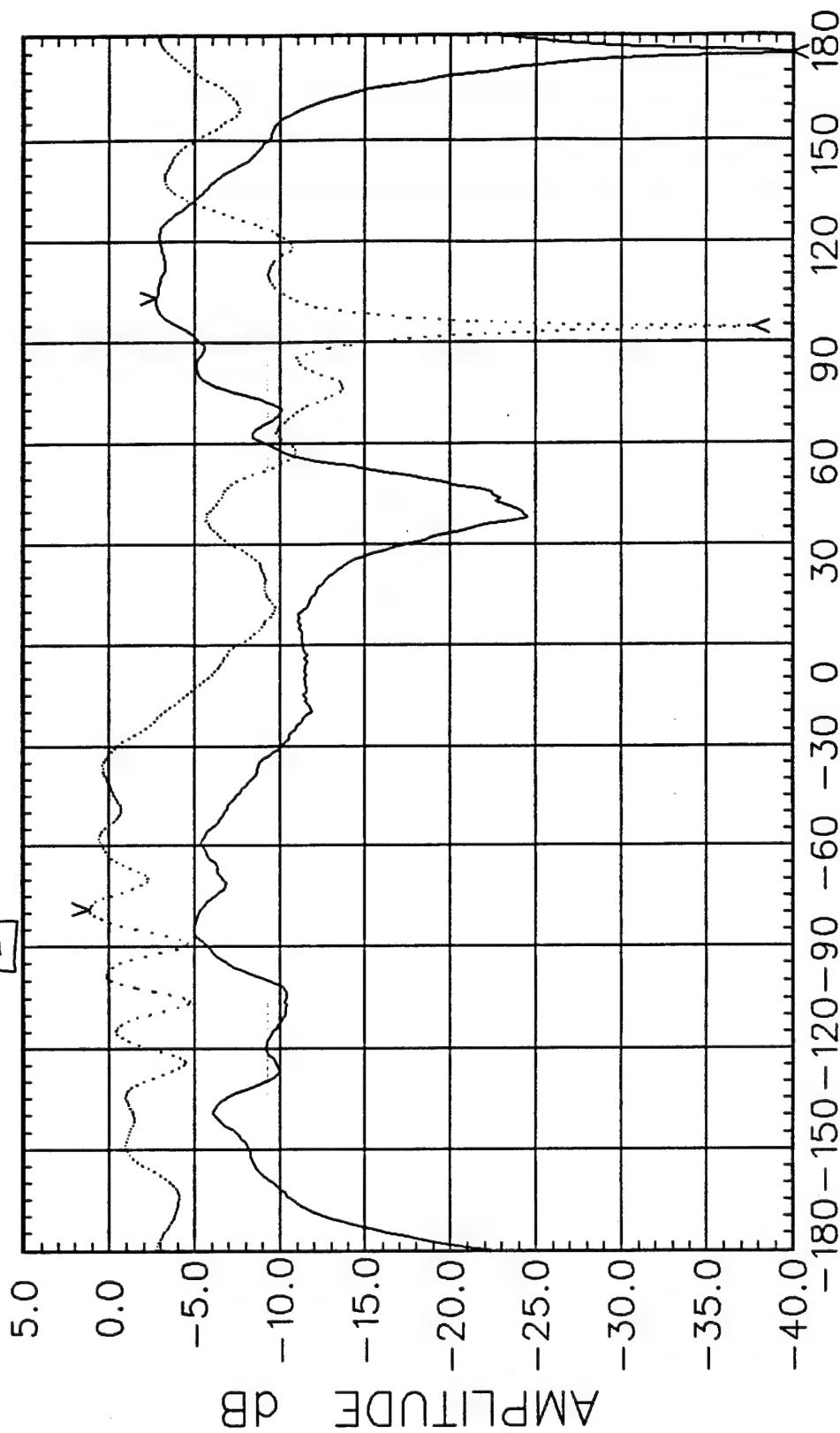
AZIMUTH
17 DEC 92

— is 860MHz A-AMPLITUDE PHI= 0deg
... is 860MHz A-AMPLITUDE PHI= 0deg

TAGGANT BENT MONOPOL

BALL AEROSPACE

0deg NORMALIZED BY 5.84dB DF1321 HAS 0dB IF ATTEN SOURCE= 0deg
0deg NORMALIZED BY 6.35dB DF1331 HAS 0dB IF ATTEN SOURCE= 90deg



THETA ANGLE

— MAX: -8.60dB at 103deg MIN: -49.17dB at 175deg
... MAX: -5.15dB at -79deg MIN: -44.12dB at 94deg



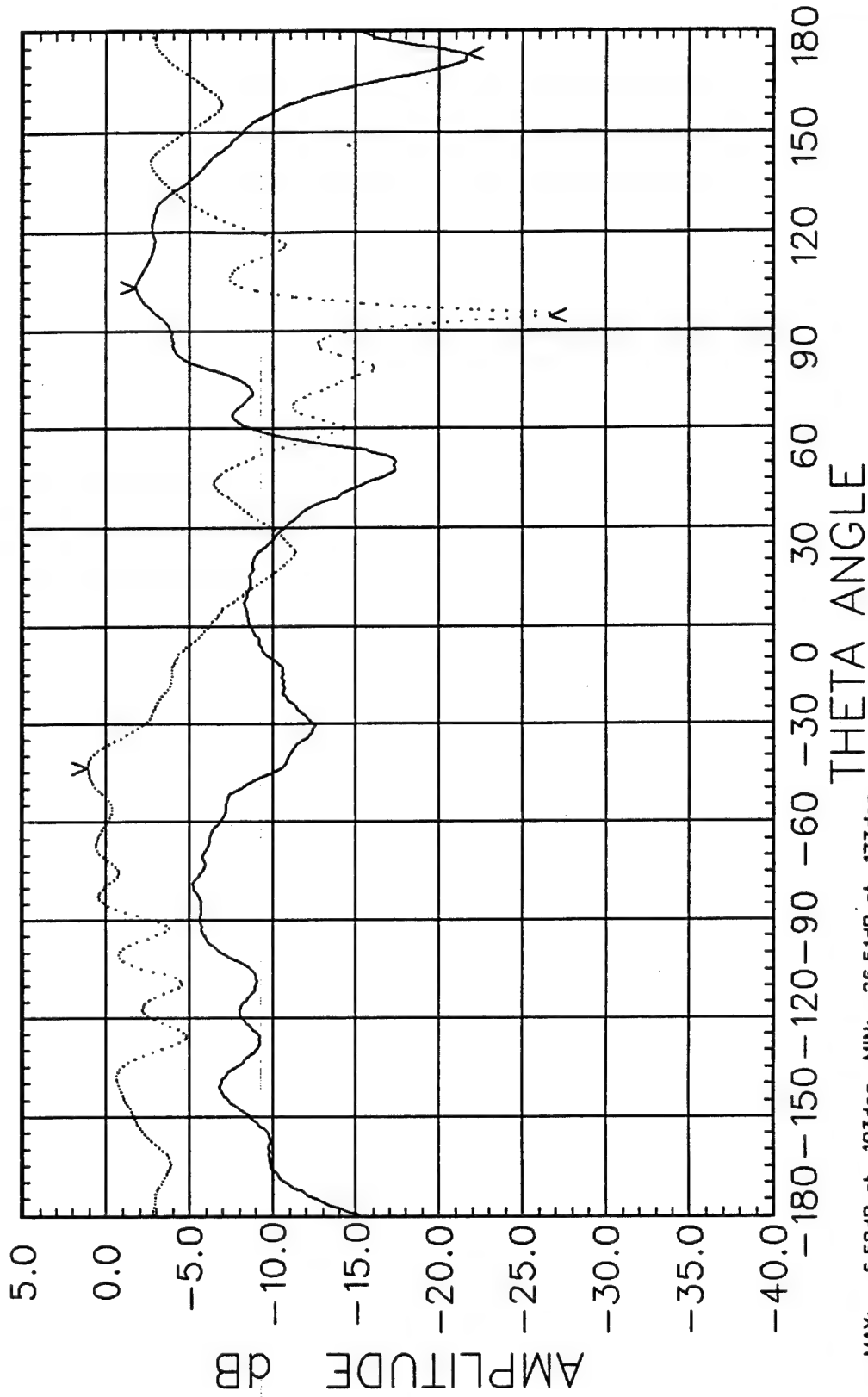
AZIMUTH
17 DEC 92

TAGGANT BENT MONOPOL

BALL AEROSPACE

— is 880MHz A-AMPLITUDE PHI=
..... is 880MHz A-AMPLITUDE PHI=

0deg NORMALIZED BY 4.80dB DF1322 HAS 0dB IF ATTEN SOURCE= 0deg V
0deg NORMALIZED BY 5.26dB DF1332 HAS 0dB IF ATTEN SOURCE= 90deg H



— MAX: -6.59dB at 103deg MIN: -26.51dB at 173deg
..... MAX: -4.17dB at -44deg MIN: -31.97dB at 94deg

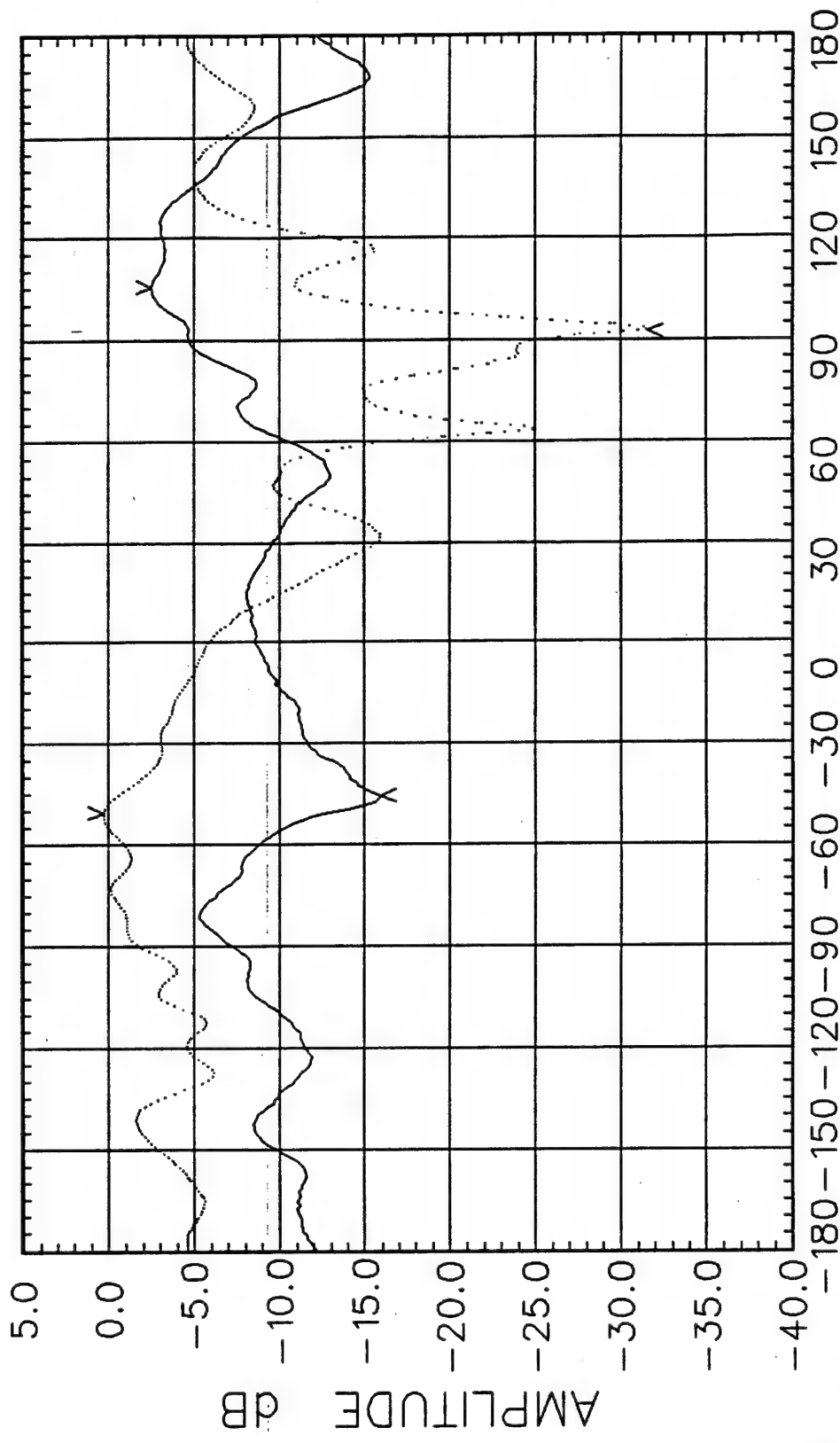
AZIMUTH

17 DEC 92

— is 900MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 3.84dB DF1323 HAS 0dB IF ATTEN SOURCE= 0deg V
... is 900MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 4.27dB DF1333 HAS 0dB IF ATTEN SOURCE= 90deg H

TAGGANT BENT MONOPOL

BALL AEROSPACE



THETA ANGLE

— MAX: -6.36dB at 105deg MIN: -19.77dB at -46deg
... MAX: -3.97dB at -51deg MIN: -35.86dB at 92deg

1) RFL01:19 MAY 92
2) RFL01:19 MAY 92

AZIMUTH

17 DEC 92

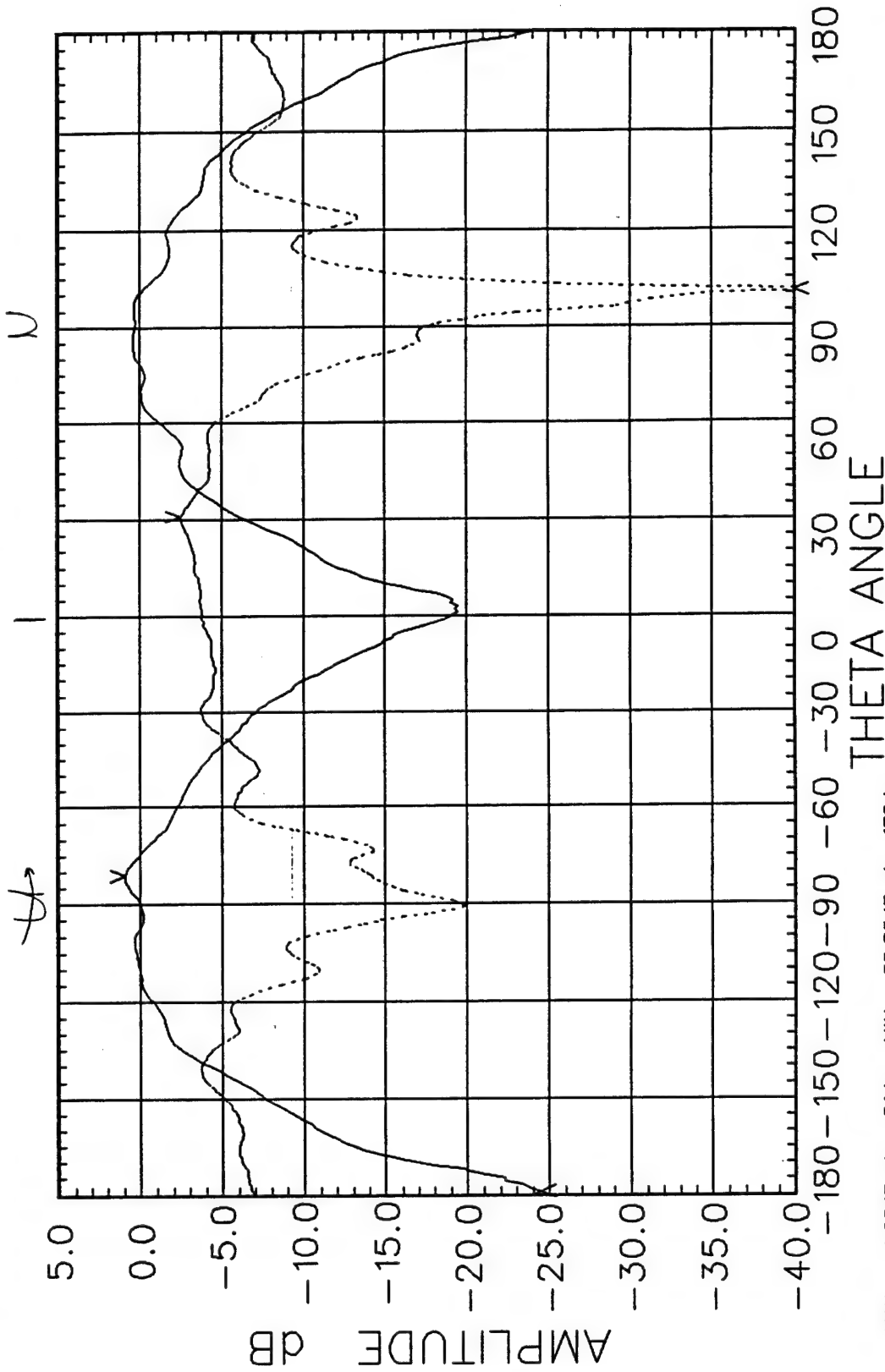
— is 860MHz A-AMPLITUDE PHI=
- - - is 860MHz A-AMPLITUDE PHI=

0deg NORMALIZED BY 5.84dB DF1181 HAS 0dB IF ATTEN SOURCE=
0deg NORMALIZED BY 6.35dB DF1191 HAS 0dB IF ATTEN SOURCE=

0deg V
90deg H

BALL AEROSPACE

TAGGANT LETTER U



— MAX: -4.90dB at -81deg MIN: -30.36dB at -179deg
- - - MAX: -8.85dB at 31deg MIN: -50.05dB at 101deg

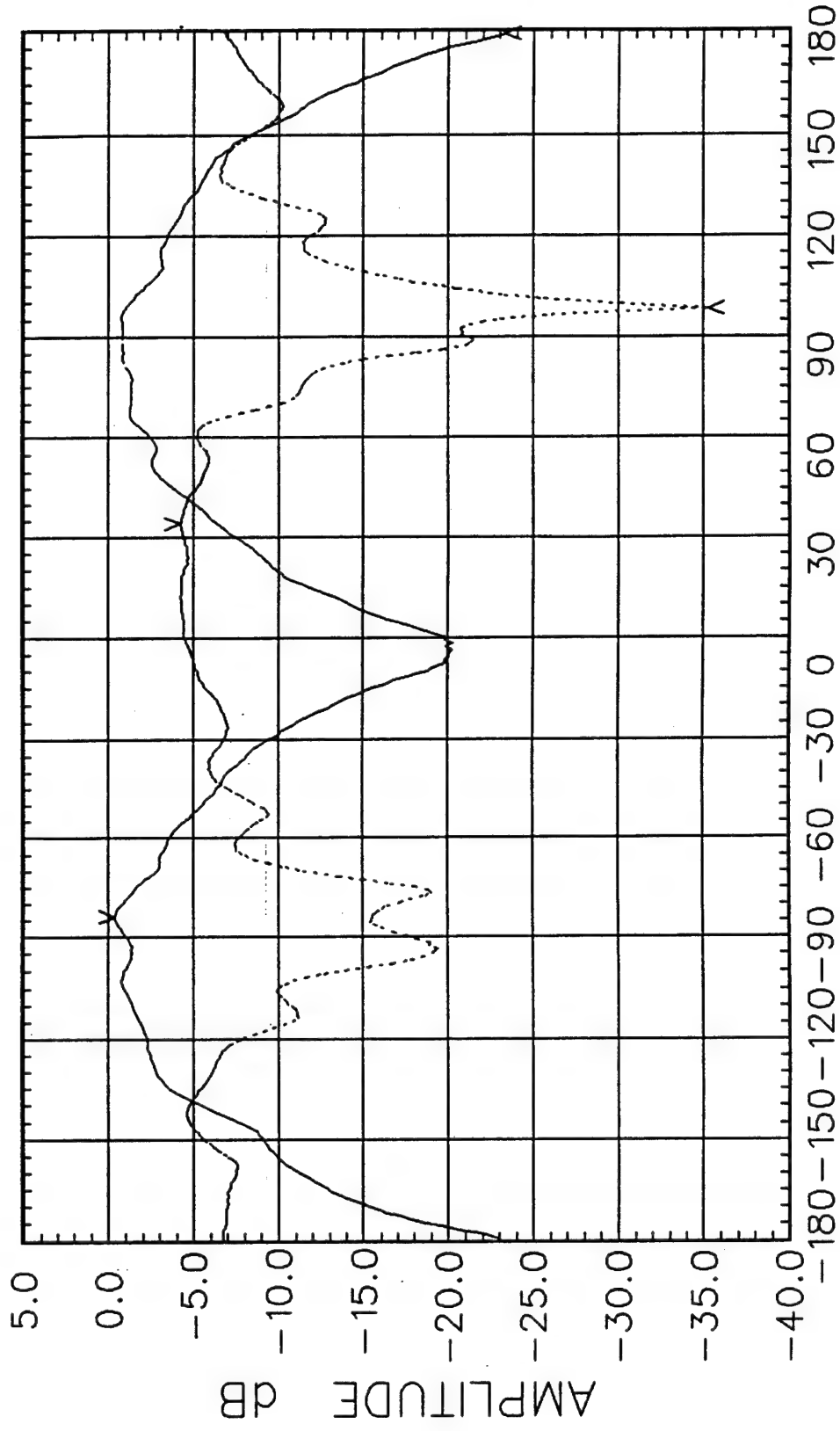
1) RPLDT:19 MAY 92
2) RPLDT:19 MAY 92

AZIMUTH
17 DEC 92

— is 880MHz A-AMPLITUDE PHI=
..... is 880MHz A-AMPLITUDE PHI=

TAGGANT LETTER U
0deg NORMALIZED BY 4.80dB DF1182 HAS 0dB IF ATTEN SOURCE=
0deg NORMALIZED BY 5.26dB DF1192 HAS 0dB IF ATTEN SOURCE=

BALL AEROSPACE



— MAX: -5.16dB at -84deg MIN: -28.16dB at 179deg
..... MAX: -9.48dB at 34deg MIN: -40.56dB at 98deg

1) RELOT:19 MAY 92
2)

17 DEC 92

AZIMUTH

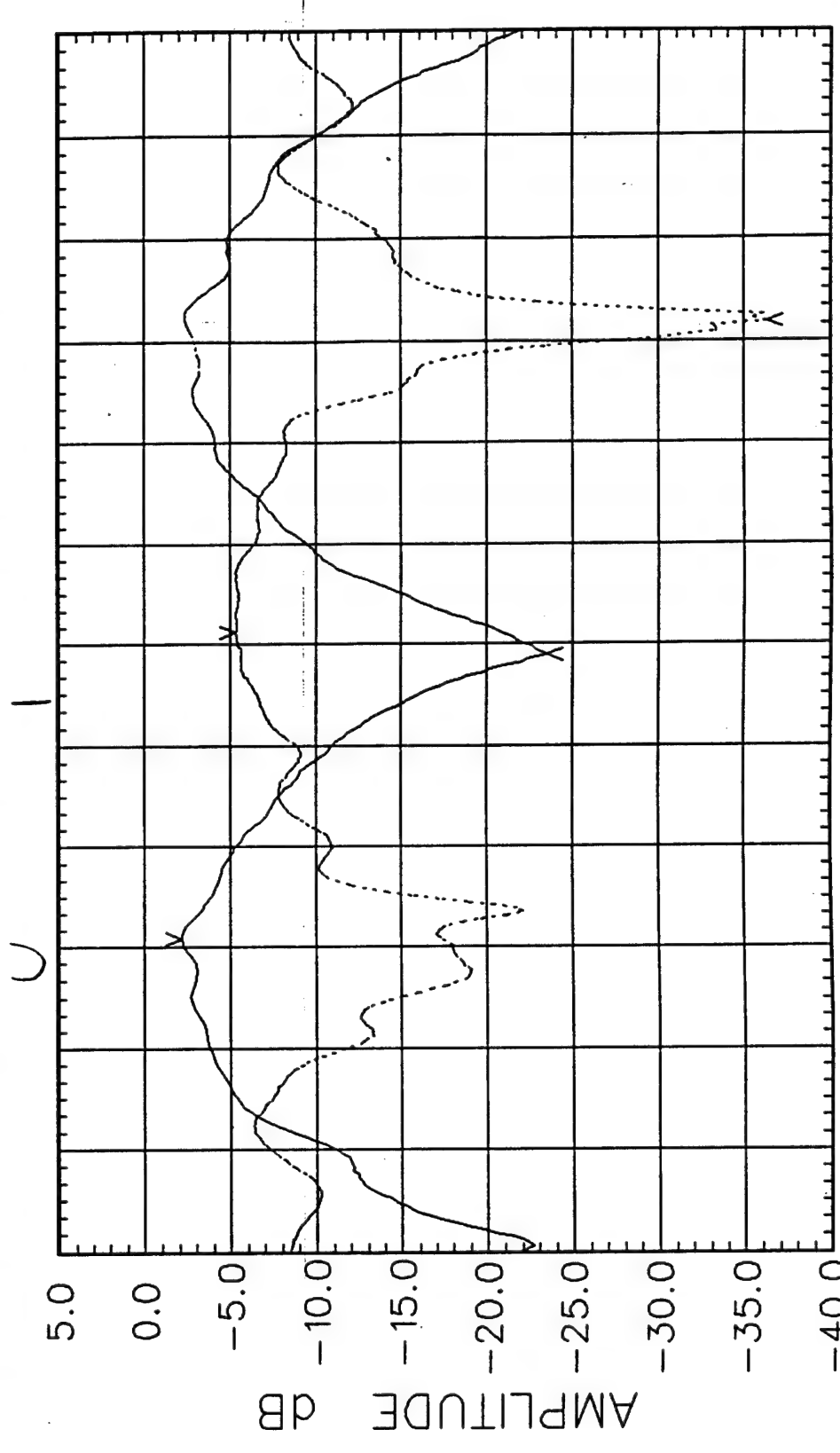
900MHz A-AMPLITUDE PHI=
900MHz A-AMPLITUDE PHI=

0deg NORMALIZED BY 3.84dB DF1183 HAS 0dB IF ATTEN SOURCE=
0deg NORMALIZED BY 4.27dB DF1193 HAS 0dB IF ATTEN SOURCE=

BALL AEROSPACE

TAGGANT LETTER U

0deg V
90deg H



MAX: -6.02dB at -88deg MIN: -27.38dB at -4deg
MAX: -9.60dB at 3deg MIN: -40.59dB at 95deg

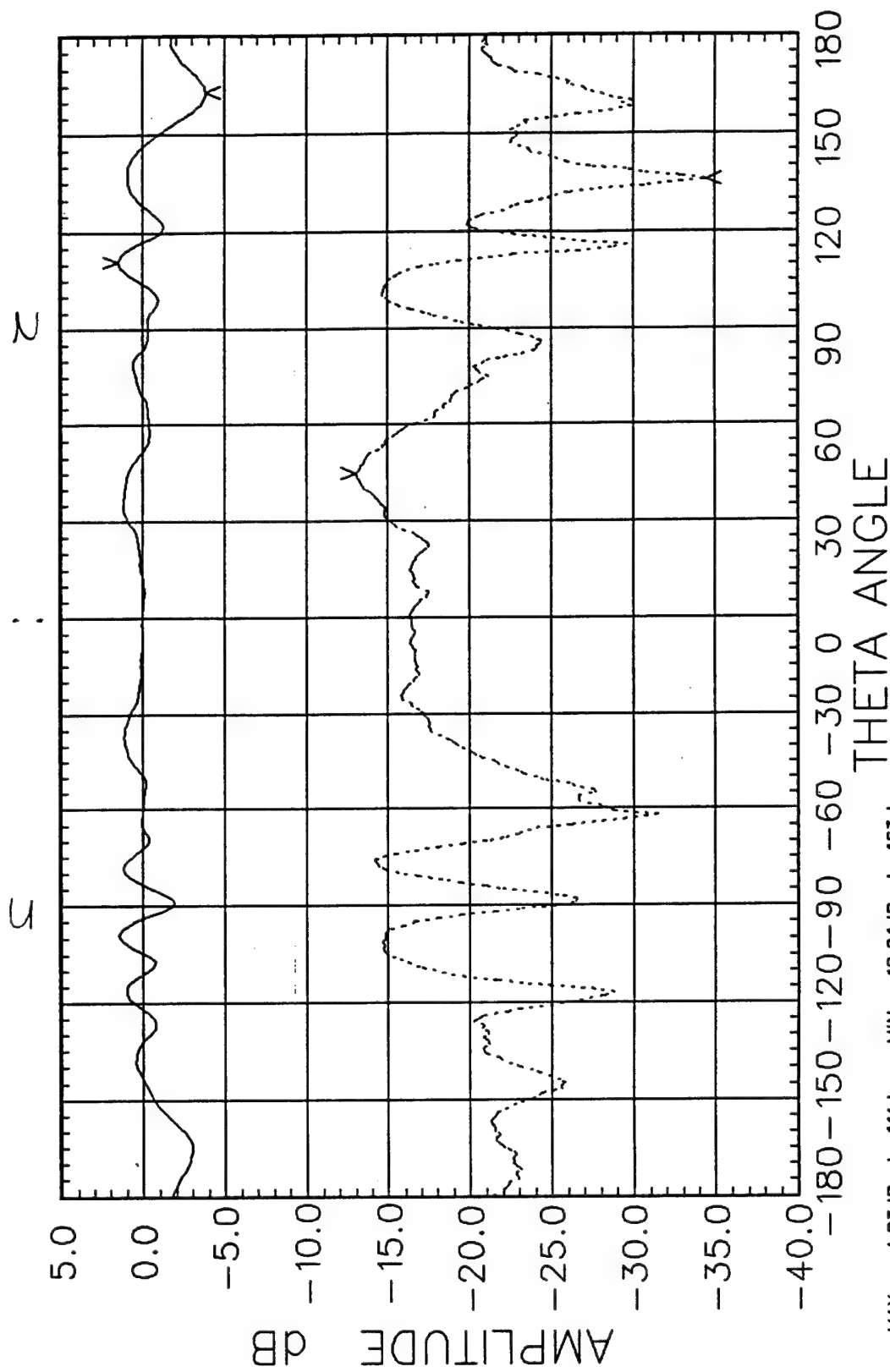
2) RELOT: 19 MAY 92

ELEVATION
17 DEC 92

BALL AEROSPACE

TAGGANT LETTER U

860MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 6.35dB DF1161 HAS 0dB IF ATTEN SOURCE= 90deg V
860MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 5.84dB DF1171 HAS 0dB IF ATTEN SOURCE= 0deg H



— MAX: -4.83dB at 111deg MIN: -10.21dB at 163deg
..... MAX: -18.90dB at 45deg MIN: -40.28dB at 136deg

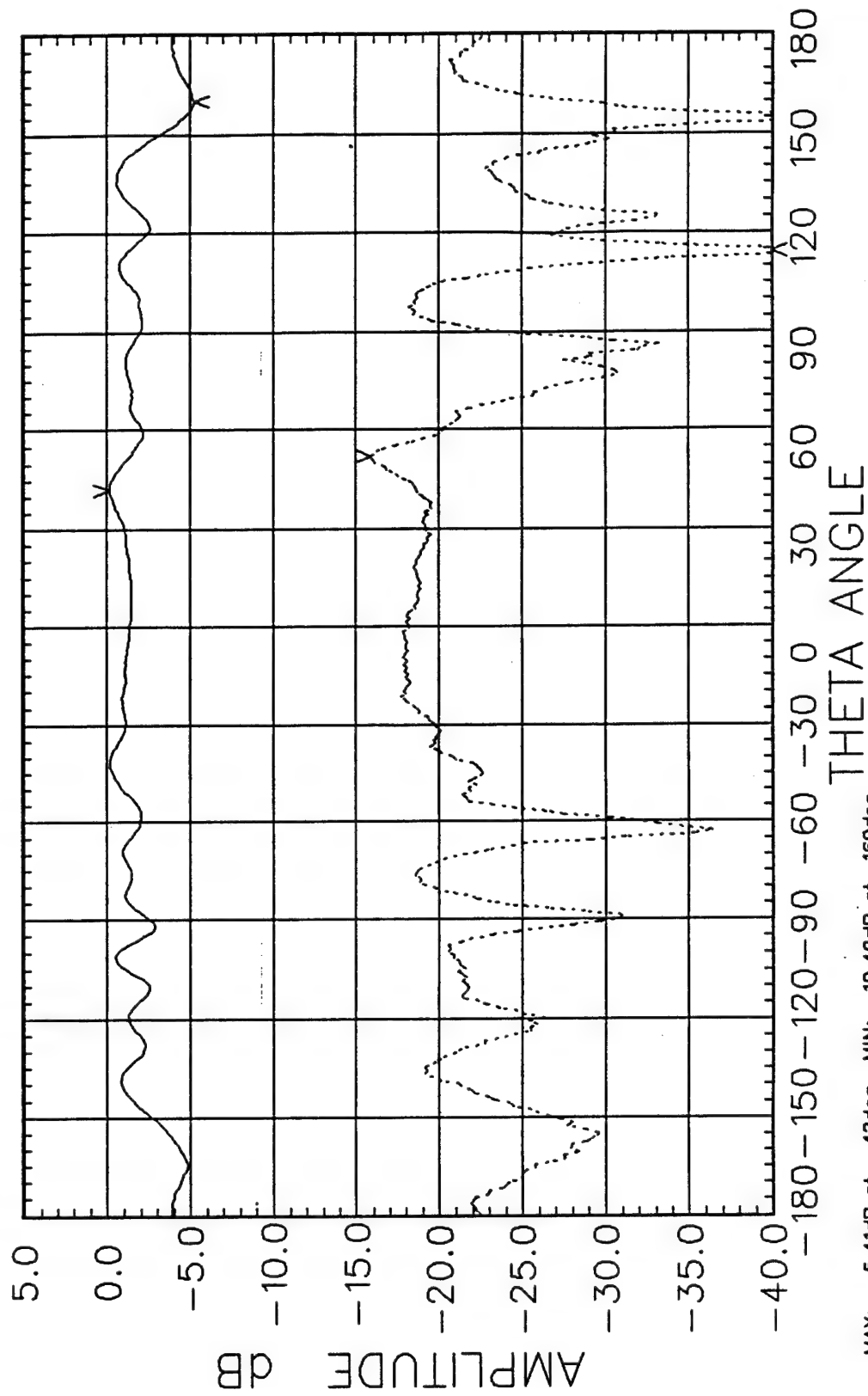
1) PLOT: 19 MAY 92
2) PLOT: 19 MAY 92

ELEVATION
17 DEC 92

BALL AEROSPACE

TAGGANT LETTER U

880MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 5.26dB DF1162 HAS 0dB IF ATTEN SOURCE= 90deg V
880MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 4.80dB DF1172 HAS 0dB IF ATTEN SOURCE= 0deg H



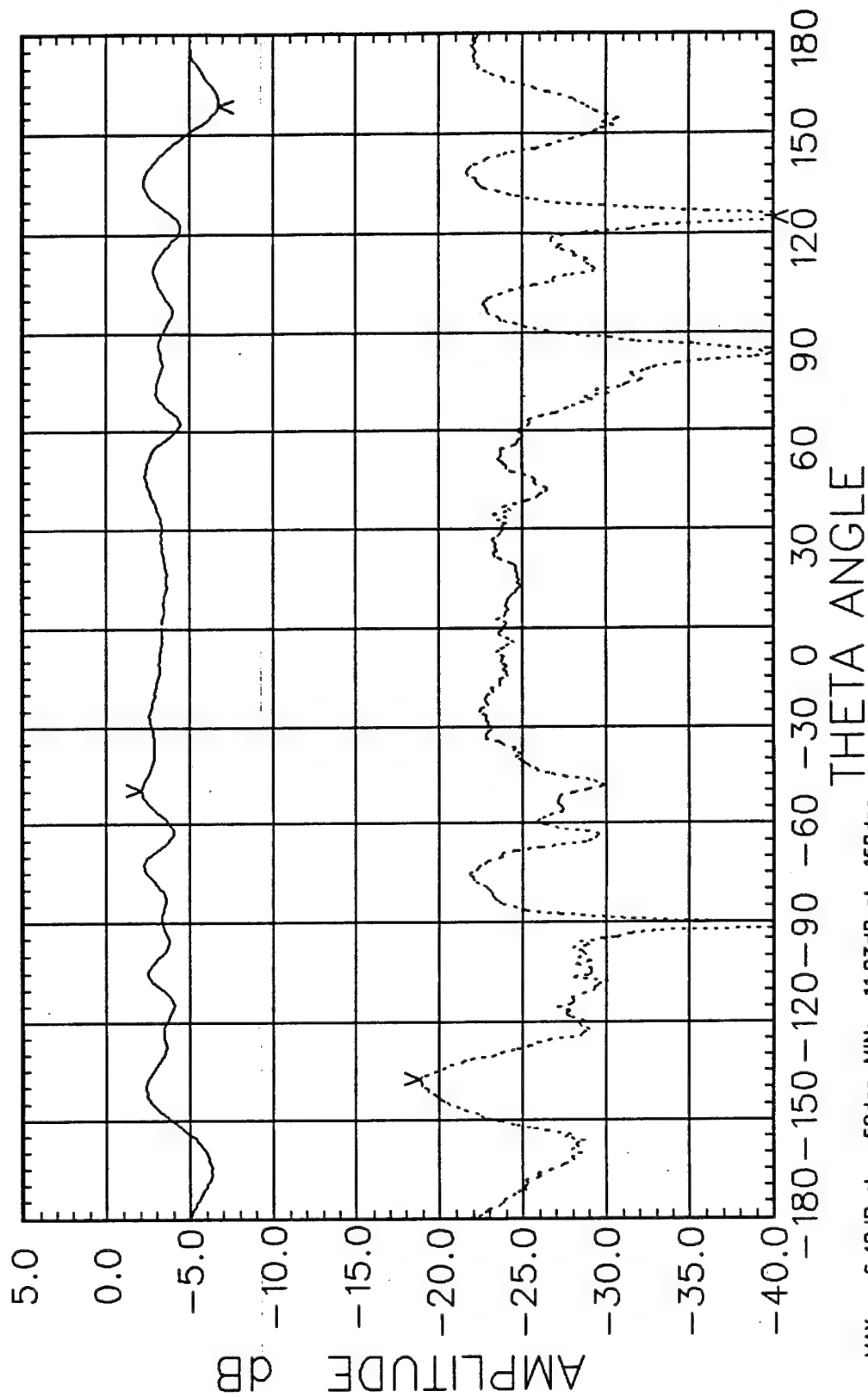
— MAX: -5.41dB at 42deg MIN: -10.49dB at 160deg
..... MAX: -20.67dB at 52deg MIN: -54.56dB at 114deg

ELEVATION
17 DEC 92

BALL AEROSPACE

TAGGANT LETTER U

900MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 4.27dB DF1163 HAS 0dB IF ATTEN SOURCE= 90deg V
900MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 3.84dB DF1173 HAS 0dB IF ATTEN SOURCE= 0deg H



— MAX: -6.40dB at -50deg MIN: -11.03dB at 158deg
- - - MAX: -22.65dB at -138deg MIN: -48.81dB at 124deg

1) RPT: 19 MAY 92
2) RPT: 19 MAY 92

AZIMUTH
17 DEC 92

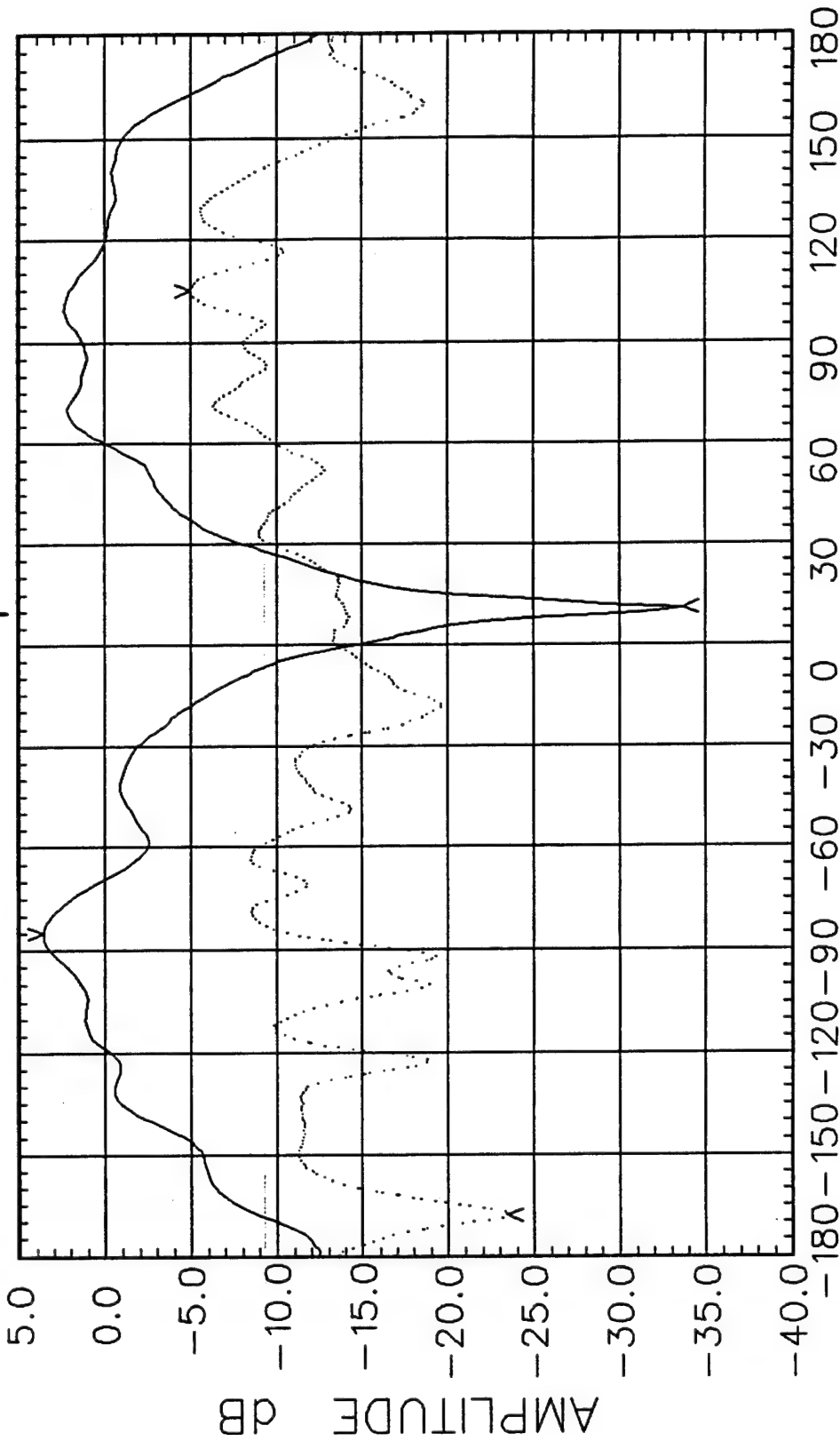
— is 860MHz A-AMPLITUDE PHI=
.... is 860MHz A-AMPLITUDE PHI=

0deg NORMALIZED BY 5.84dB DF1281 HAS 0deg IF ATTEN SOURCE=
0deg NORMALIZED BY 6.35dB DF1291 HAS 0deg IF ATTEN SOURCE=

BALL AEROSPACE

TAGGANT LETTER N

N →



— MAX: -2.27dB at -85deg MIN: -39.55dB at 11deg
.... MAX: -11.33dB at 105deg MIN: -29.82dB at -168deg

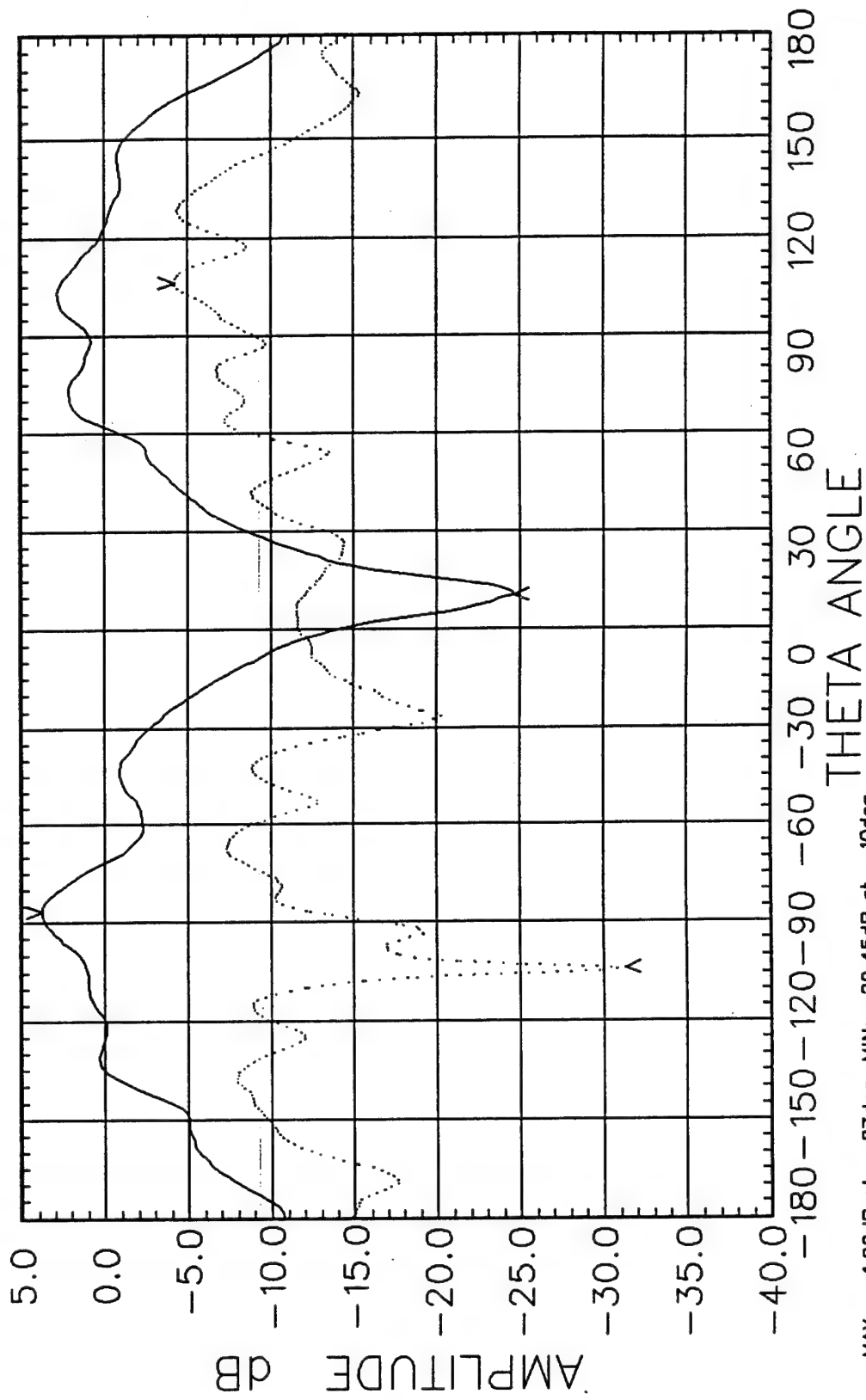
AZIMUTH
17 DEC 92

— is 880MHz A-AMPLITUDE PHI=
... is 880MHz A-AMPLITUDE PHI=

TAGGANT LETTER N

0deg NORMALIZED BY 4.80dB DF1282 HAS 0dB IF ATTEN SOURCE= 0deg V
0deg NORMALIZED BY 5.26dB DF1292 HAS 0dB IF ATTEN SOURCE= 90deg H

BALL AEROSPACE



1) PLOT: 19 MAY 92
2) PLOT: 19 MAY 92

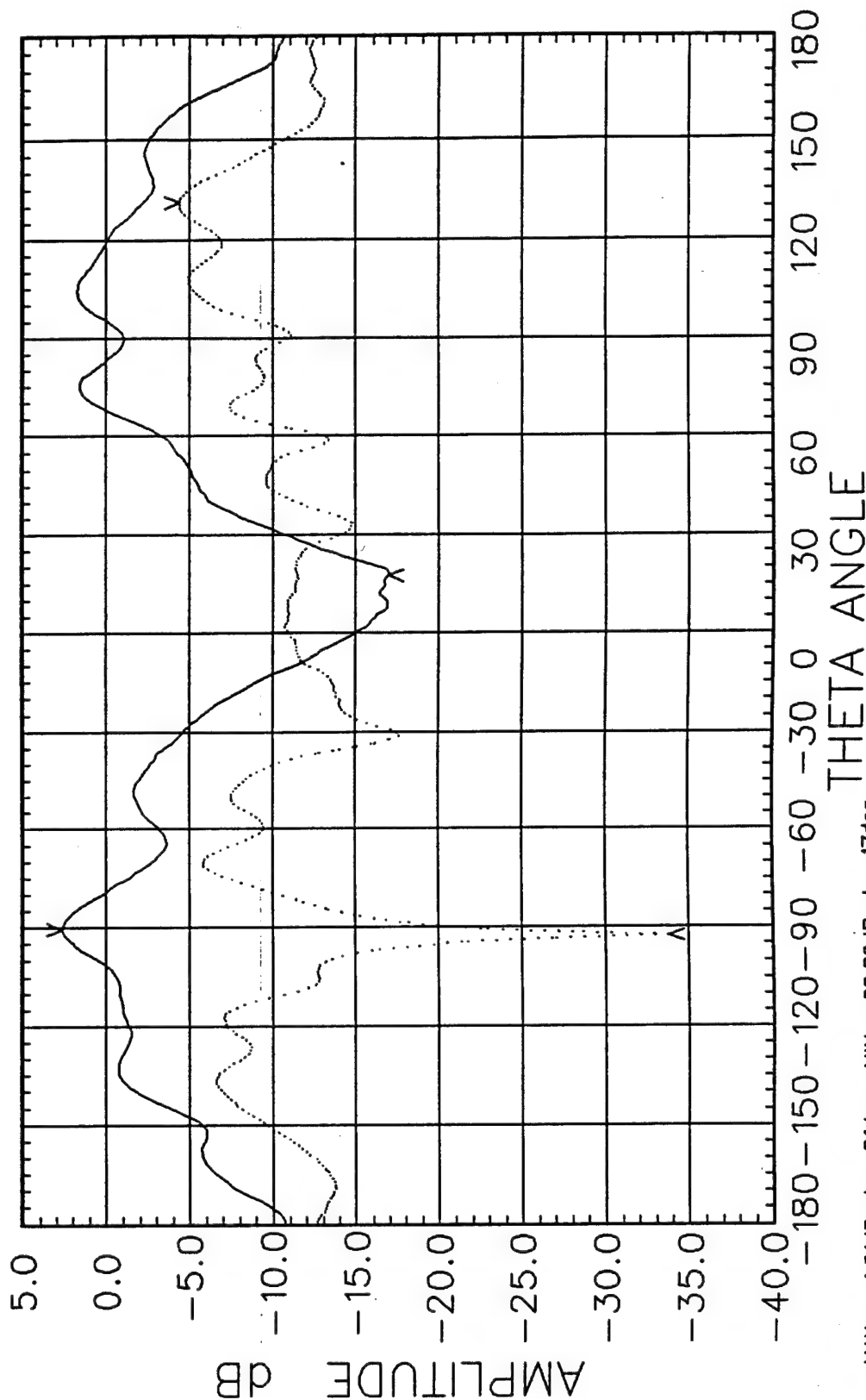
AZIMUTH
17 DEC 92

— is 900MHz A-AMPLITUDE PHI=
... is 900MHz A-AMPLITUDE PHI=

0deg NORMALIZED BY 3.84dB DF1283 HAS 0dB IF ATTEN SOURCE=
0deg NORMALIZED BY 4.27dB DF1293 HAS 0dB IF ATTEN SOURCE=

TAGGANT LETTER N

BALL AEROSPACE



ELEVATION
17 DEC 92

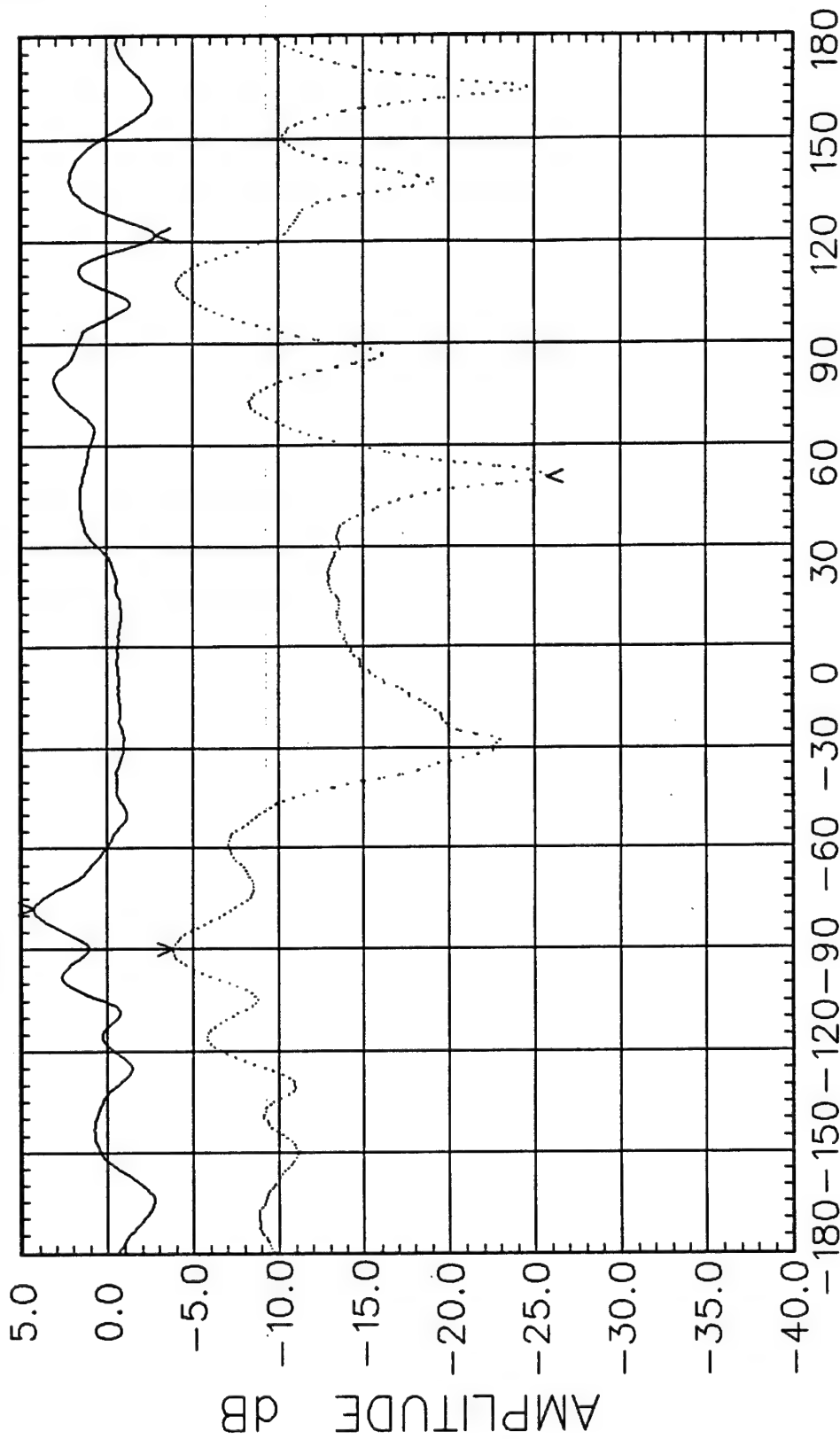
— is 860MHz A-AMPLITUDE PHI=
.... is 860MHz A-AMPLITUDE PHI=

TAGGANT LETTER N

0deg NORMALIZED BY 6.35dB DF1301 HAS 0dB IF ATTEN SOURCE= 90deg
0deg NORMALIZED BY 5.84dB DF1311 HAS 0dB IF ATTEN SOURCE= 0deg

BALL AEROSPACE

2



— MAX: -2.09dB at -78deg MIN: -9.17dB at 122deg
.... MAX: -9.55dB at -90deg MIN: -31.59dB at 51deg

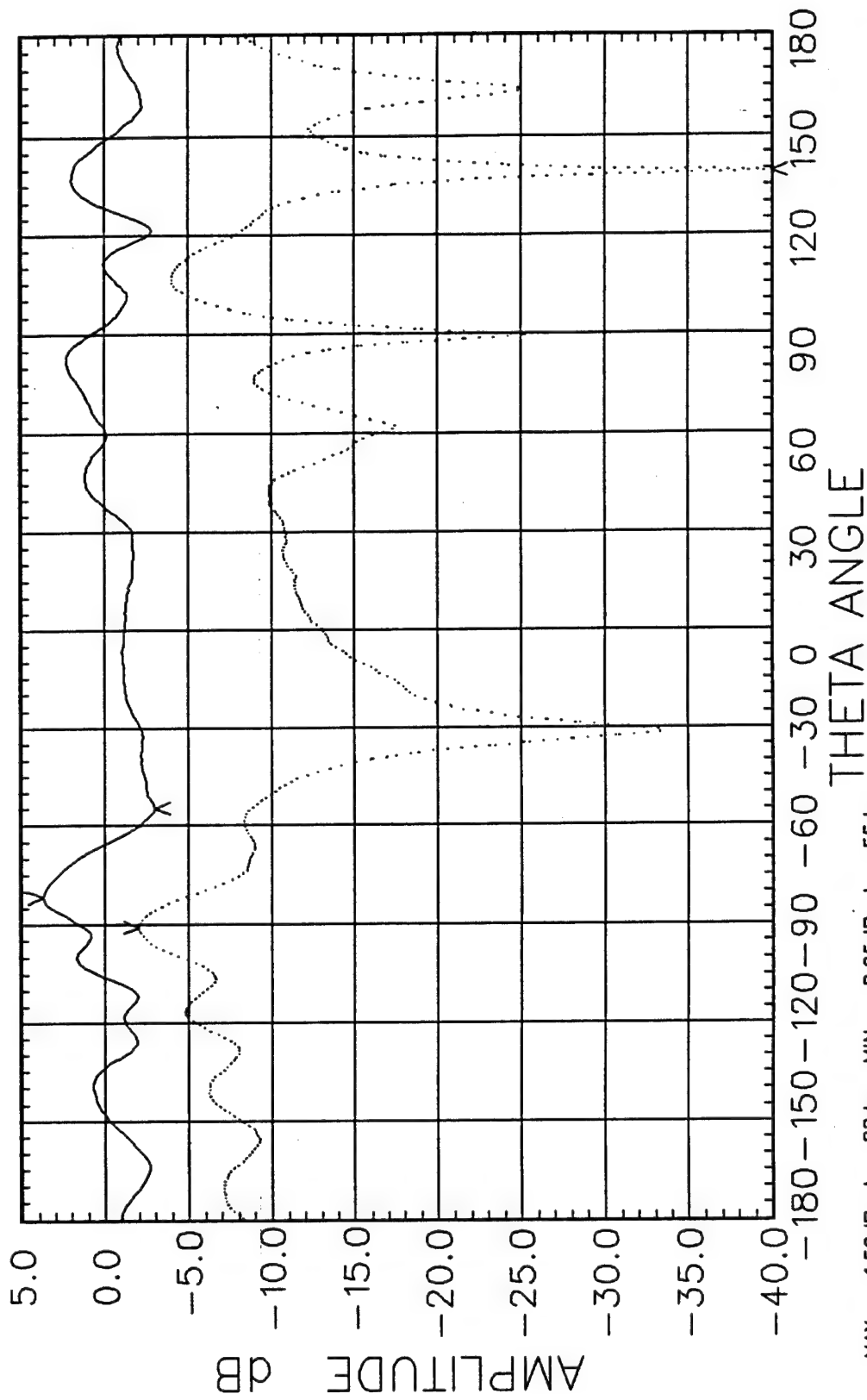
ELEVATION
17 DEC 92

— is 880MHz A-AMPLITUDE PHI=
... is 880MHz A-AMPLITUDE PHI=

TAGGANT LETTER N

BALL AEROSPACE

0deg NORMALIZED BY 5.26dB DF1302 HAS 0dB IF ATTEN SOURCE= 90deg H
0deg NORMALIZED BY 4.80dB DF1312 HAS 0dB IF ATTEN SOURCE= 0deg V

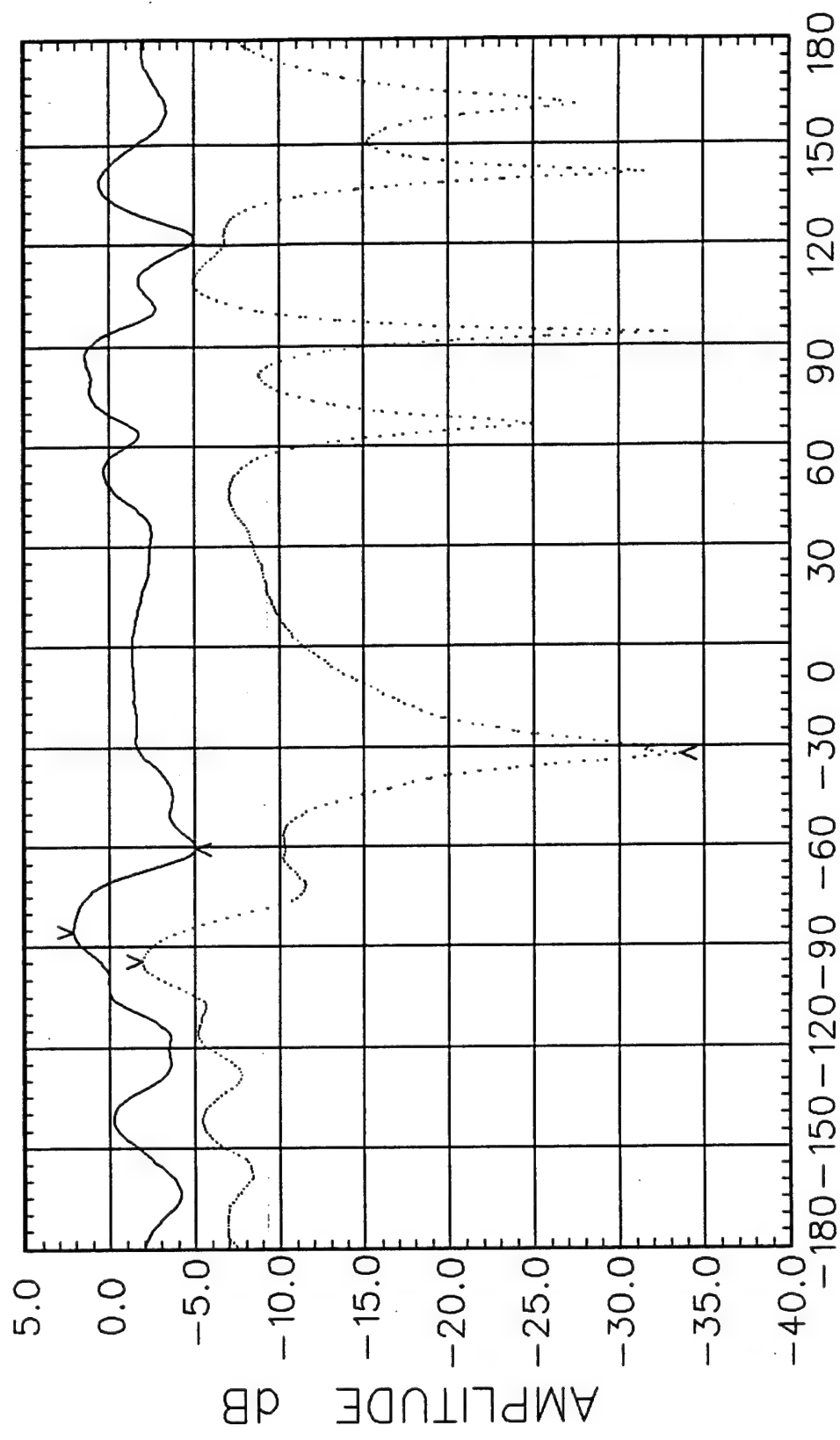


ELEVATION
17 DEC 92

BALL AEROSPACE

TAGCANT LETTER N

900MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 4.27dB DF1303 HAS 0dB IF ATTEN SOURCE= 90deg H
900MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 3.84dB DF1313 HAS 0dB IF ATTEN SOURCE= 0deg V



MAX: -2.16dB at -86deg MIN: -9.33dB at -61deg
MAX: -5.78dB at -95deg MIN: -37.46dB at -33deg

2) RPL01:19 MAY 92

AZIMUTH
17 DEC 92

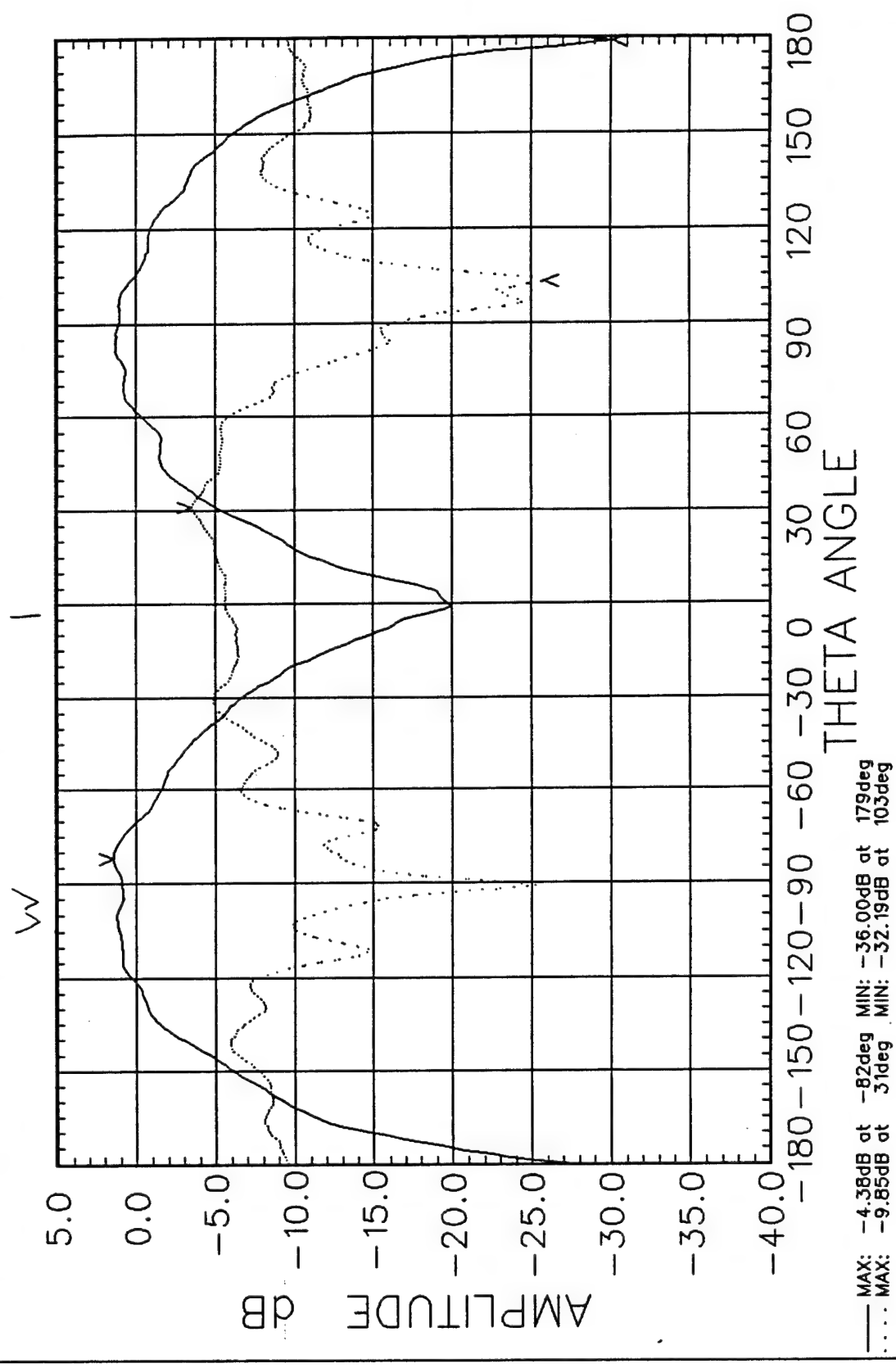
— is 860MHz A-AMPLITUDE PHI=
... is 860MHz A-AMPLITUDE PHI=

0deg NORMALIZED BY 5.84dB DF1201 HAS 0dB IF ATTEN SOURCE=
0deg NORMALIZED BY 6.35dB DF1211 HAS 0dB IF ATTEN SOURCE=

BALL AEROSPACE

TAGGANT LETTER W

0deg V
90deg H



1) REFLUT:19 MAY 92
2)

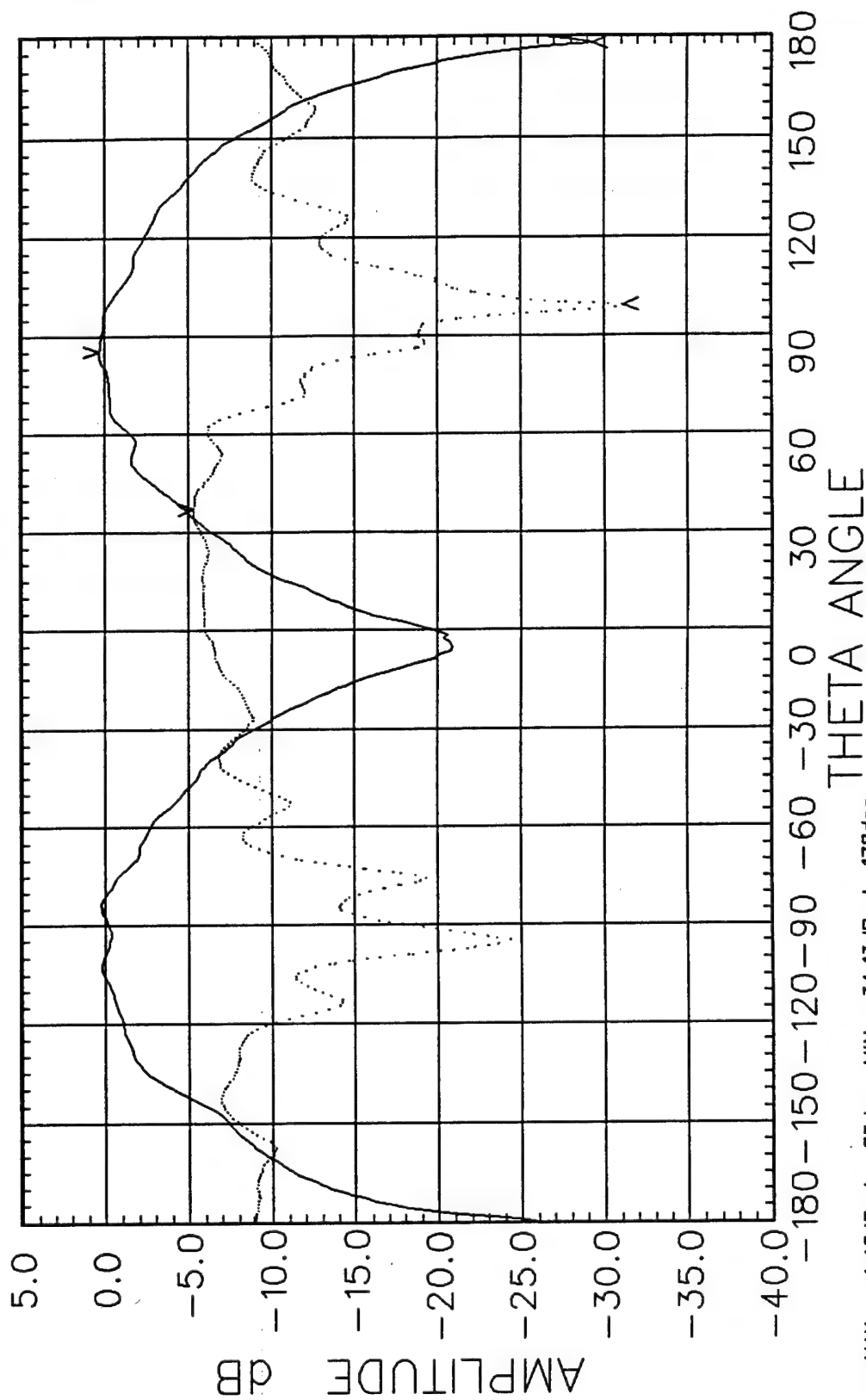
AZIMUTH
17 DEC 92

— is 880MHz A-AMPLITUDE PHI=
... is 880MHz A-AMPLITUDE PHI=

0deg NORMALIZED BY 4.80dB DF1202 HAS 0dB IF ATTEN SOURCE= 0deg V
0deg NORMALIZED BY 5.26dB DF1212 HAS 0dB IF ATTEN SOURCE= 90deg H

BALL AEROSPACE

TAGGANT LETTER W



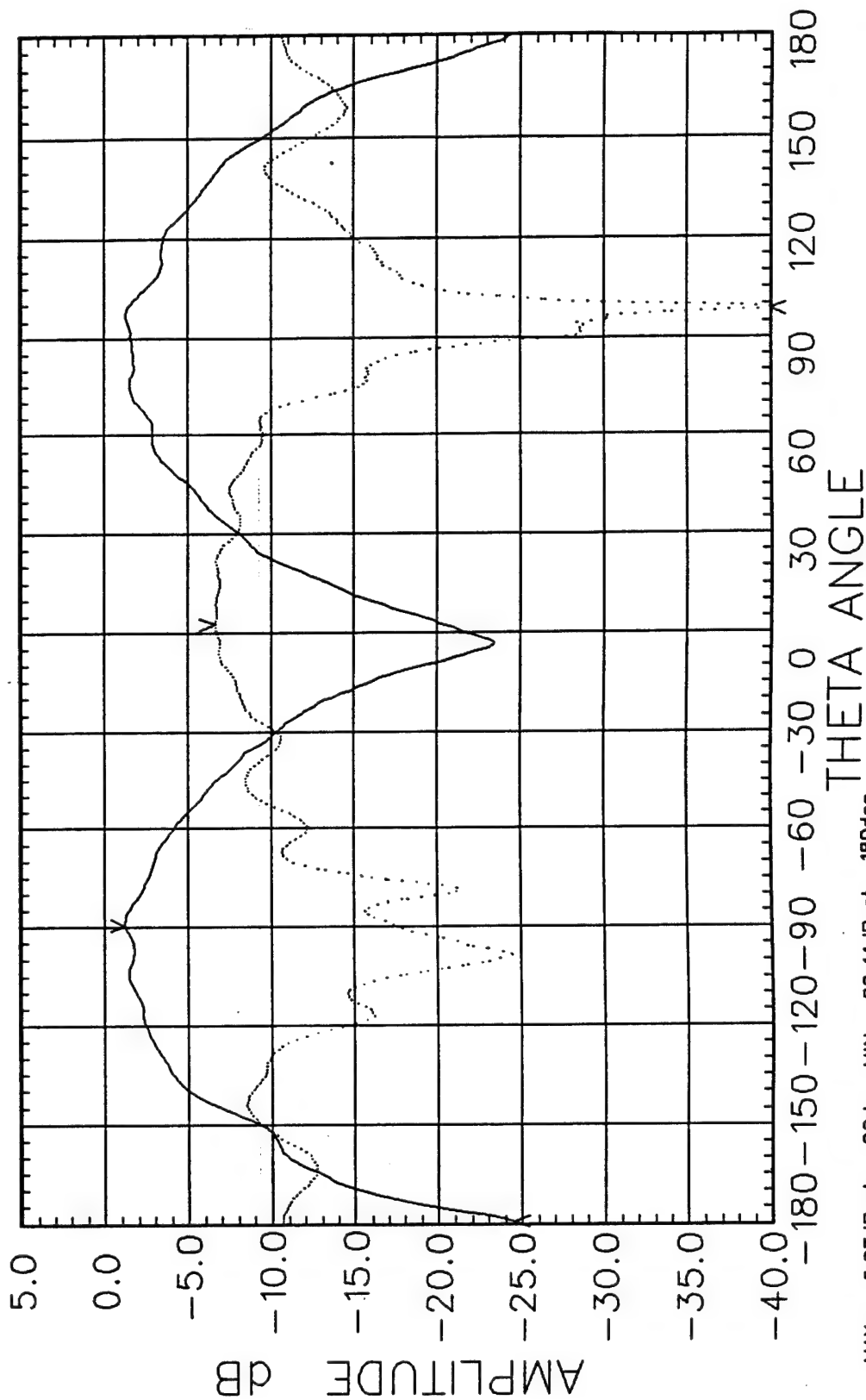
— MAX: -4.46dB at 85deg MIN: -34.13dB at 178deg
... MAX: -10.56dB at 37deg MIN: -36.42dB at 99deg

AZIMUTH
17 DEC 92

TAGGANT LETTER W

BALL AEROSPACE

900MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 3.84dB DF1203 HAS 0dB IF ATTEN SOURCE= 0deg V
900MHz A-AMPLITUDE PHI= 0deg NORMALIZED BY 4.27dB DF1213 HAS 0dB IF ATTEN SOURCE= 90deg H



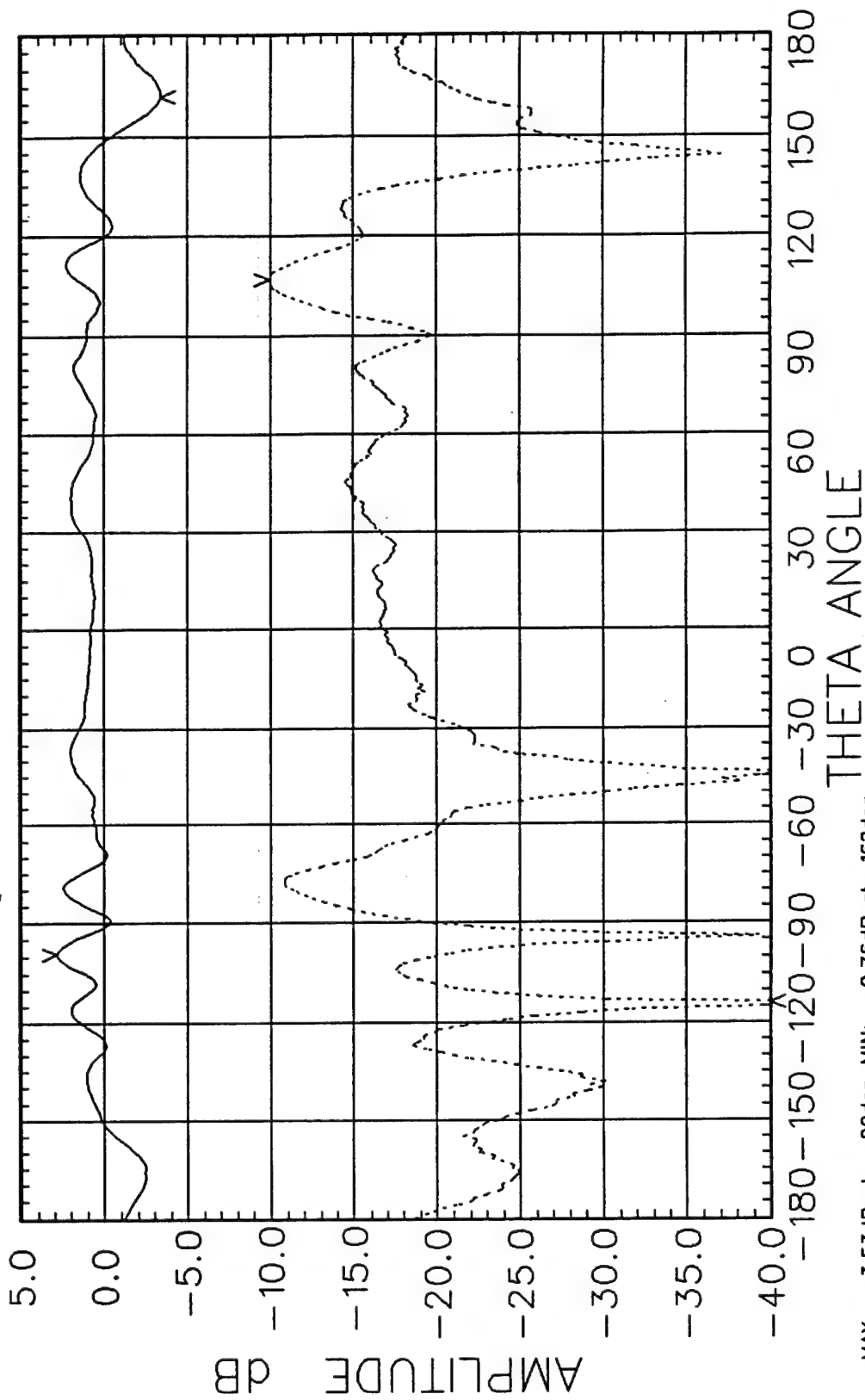
— MAX: -5.07dB at -90deg MIN: -28.41dB at -180deg
.... MAX: -10.91dB at 3deg MIN: -45.32dB at 98deg

ELEVATION
17 DEC 92

— is 860MHz A-AMPLITUDE PHI=
..... is 860MHz A-AMPLITUDE PHI=

TAGGANT LETTER W
0deg NORMALIZED BY 6.35dB DF1221 HAS 0dB IF ATTEN SOURCE= 90deg H
0deg NORMALIZED BY 5.84dB DF1231 HAS 0dB IF ATTEN SOURCE= 0deg V

BALL AEROSPACE



— MAX: -3.53dB at -99deg MIN: -9.76dB at 162deg
..... MAX: -15.78dB at 107deg MIN: -49.74dB at -114deg

1) RPL01:19 MAY 92
2)

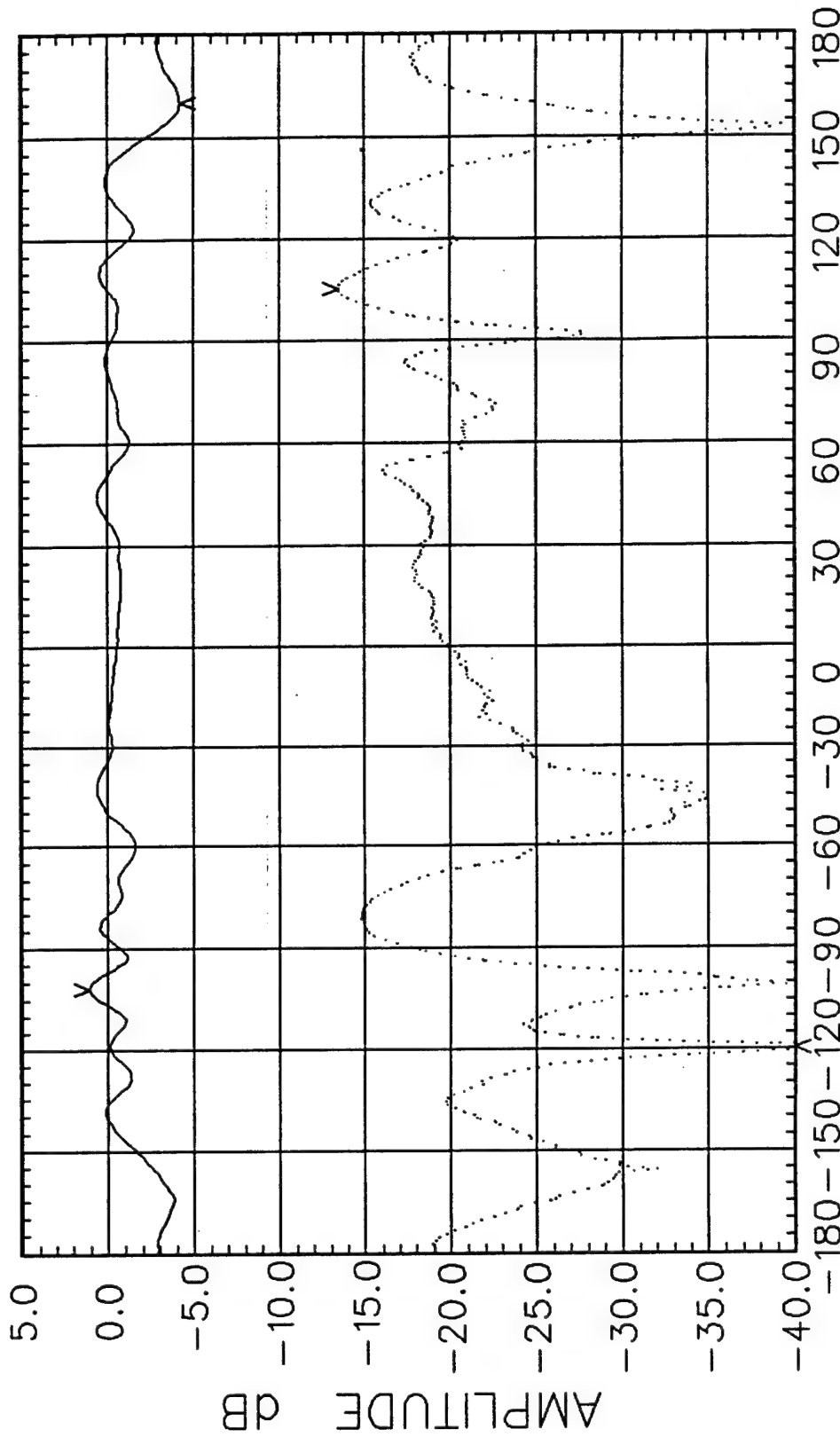
ELEVATION
17 DEC 92

— is 880MHz A-AMPLITUDE PHI=
... is 880MHz A-AMPLITUDE PHI=

0deg NORMALIZED BY 5.26dB DF1222 HAS 0dB IF ATTEN SOURCE= 90deg H
0deg NORMALIZED BY 4.80dB DF1232 HAS 0dB IF ATTEN SOURCE= 0deg V

BALL AEROSPACE

TAGGANT LETTER W



— MAX: -4.20dB at -102deg MIN: -9.49dB at 160deg
... MAX: -18.27dB at 105deg MIN: -58.43dB at -120deg

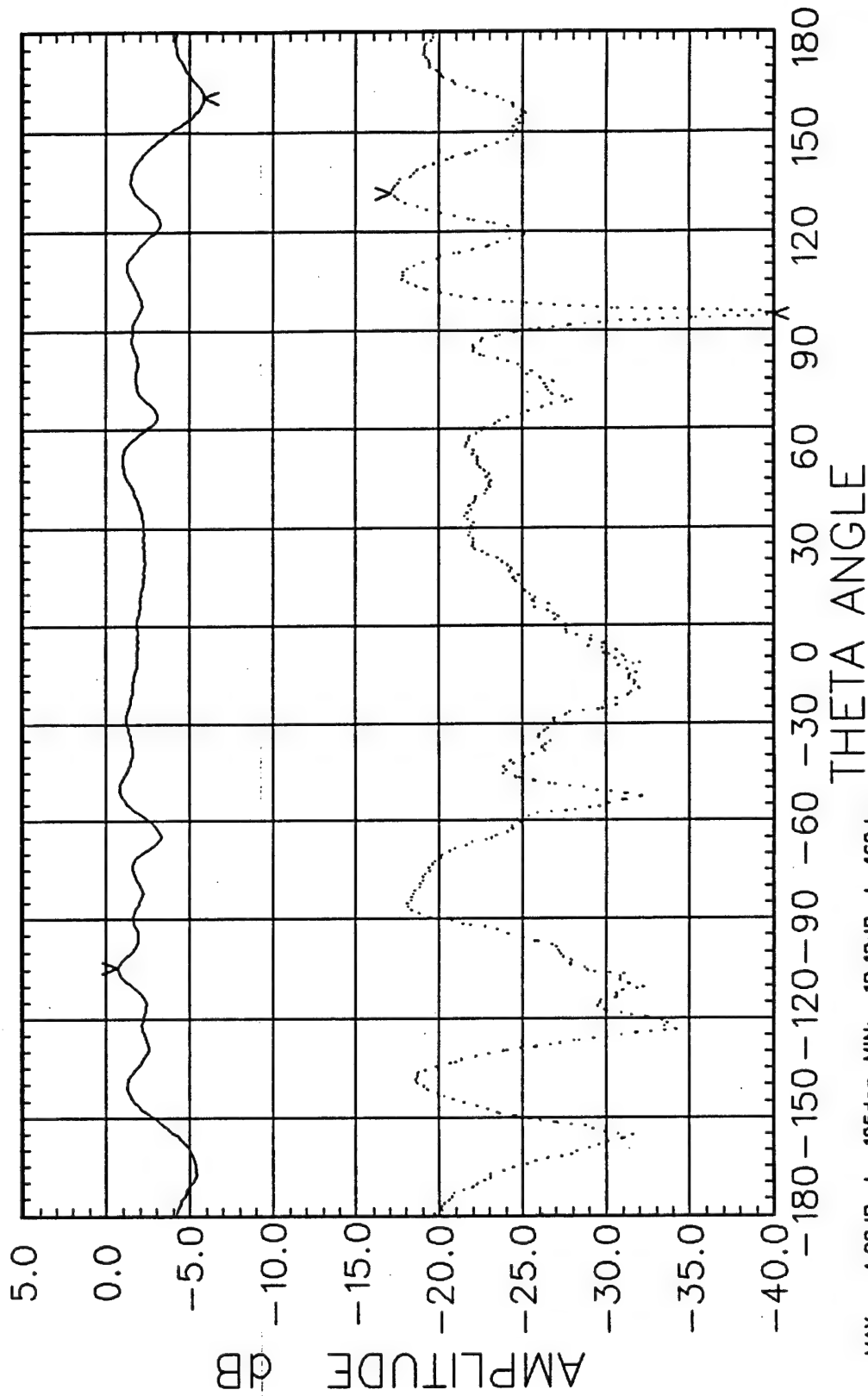
ELEVATION
17 DEC 92

— is 900MHz A-AMPLITUDE PHI=
.... is 900MHz A-AMPLITUDE PHI=

0deg NORMALIZED BY 4.27dB DF1223 HAS 0dB IF ATTEN SOURCE= 90deg H
0deg NORMALIZED BY 3.84dB DF1233 HAS 0dB IF ATTEN SOURCE= 0deg V

BALL AEROSPACE

TAGGANT LETTER W



— MAX: -4.99dB at -105deg MIN: -10.12dB at 160deg
.... MAX: -20.91dB at 131deg MIN: -46.09dB at 94deg

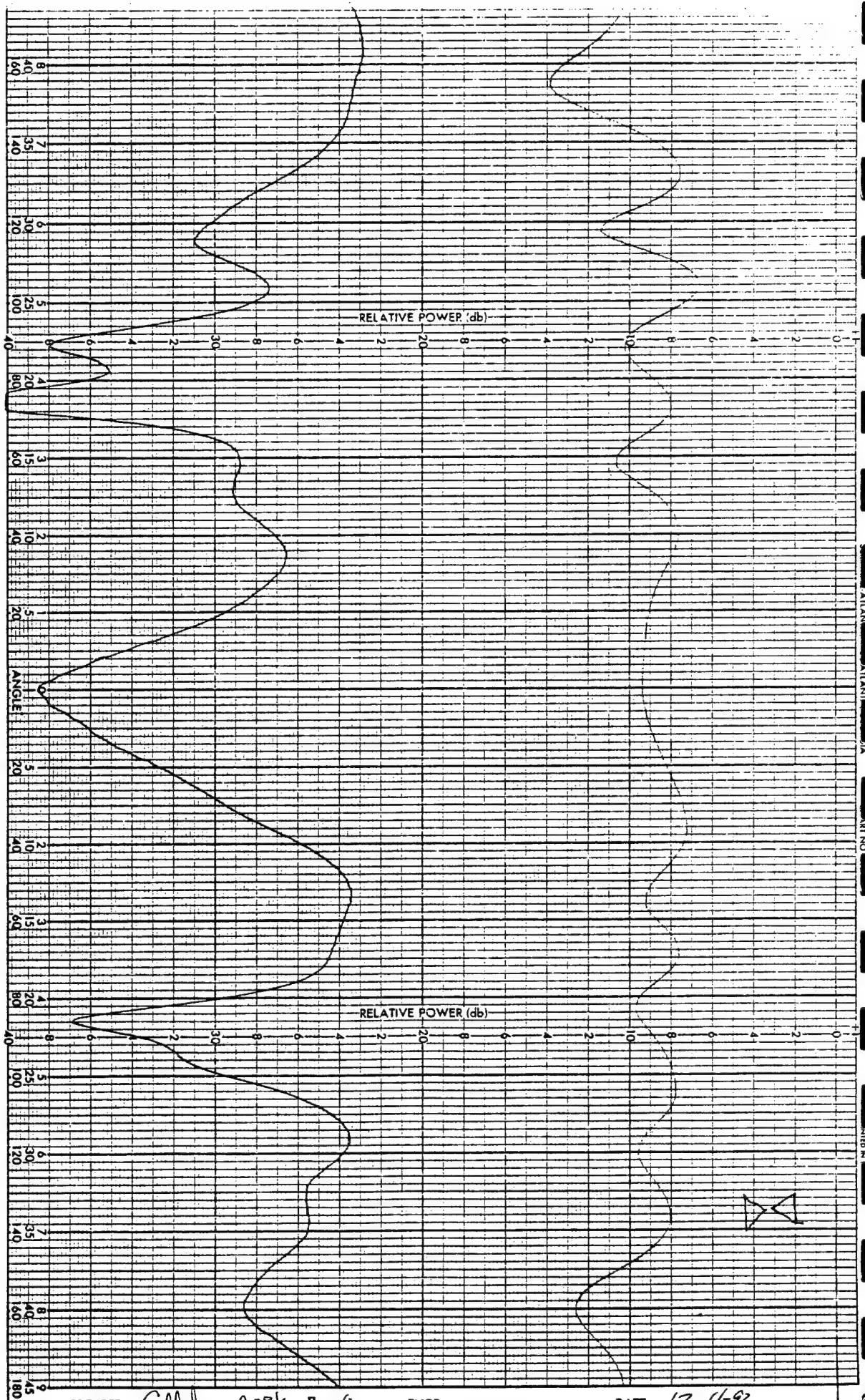


Appendix II

Argos Bowtle Antenna

Avegas 401 MHz 90° Bowtie Antenna

Freq	SG LPDA on channel	Oct Bandwidth	H	Gain (dBil) V
391	-3.0	-11.0	+2.2	-10.8
401	-2.4	-10.4	+1.5	-10.6
411	-2.8	-10.8	+1.6	-10.7



PROJECT
REMARKS

Cellular 90° Beam
890 MHz

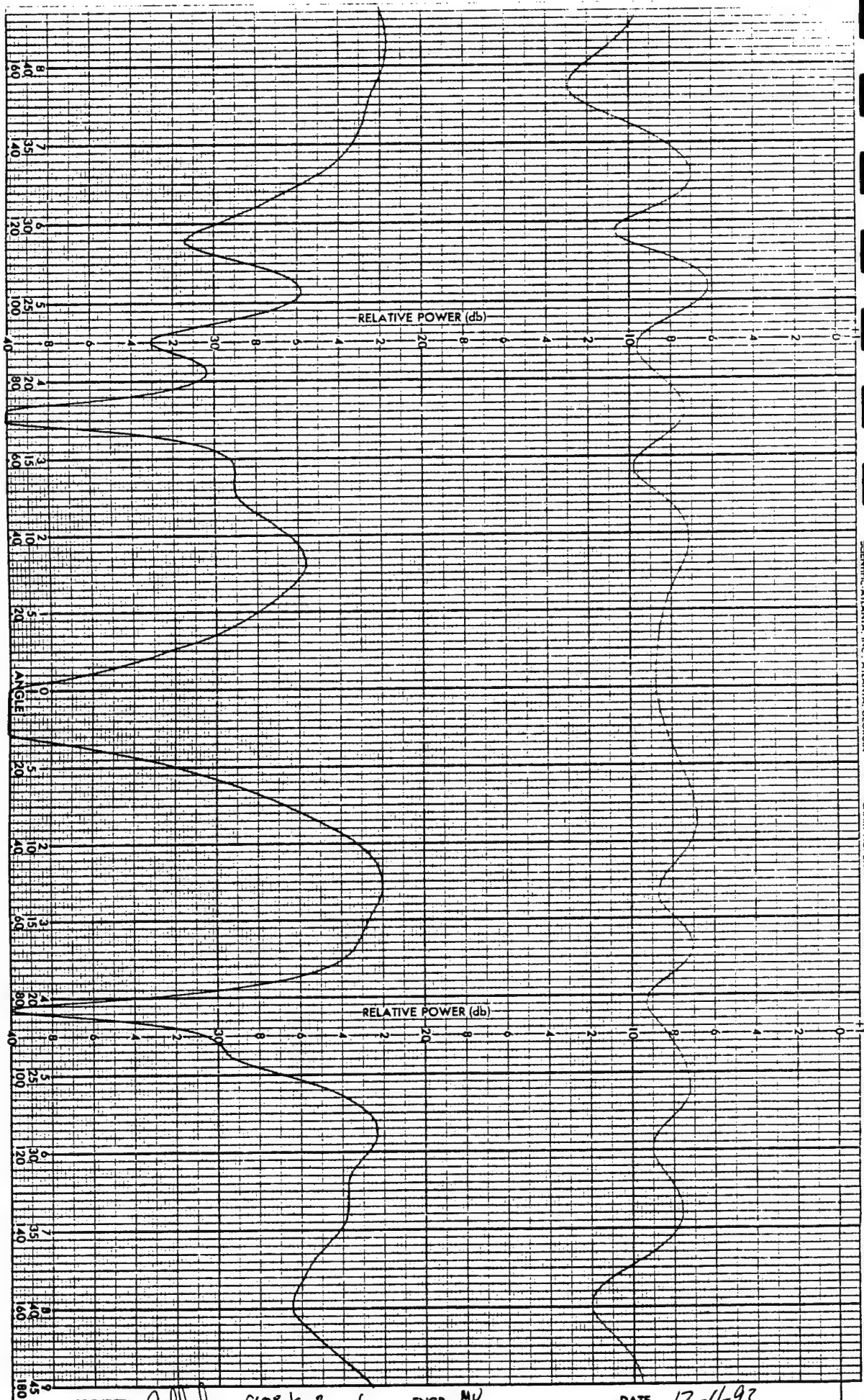
ENGR

DI-Hen

DATE 12-11-92

A=10

106743
1992



PROJECT
REMARKS

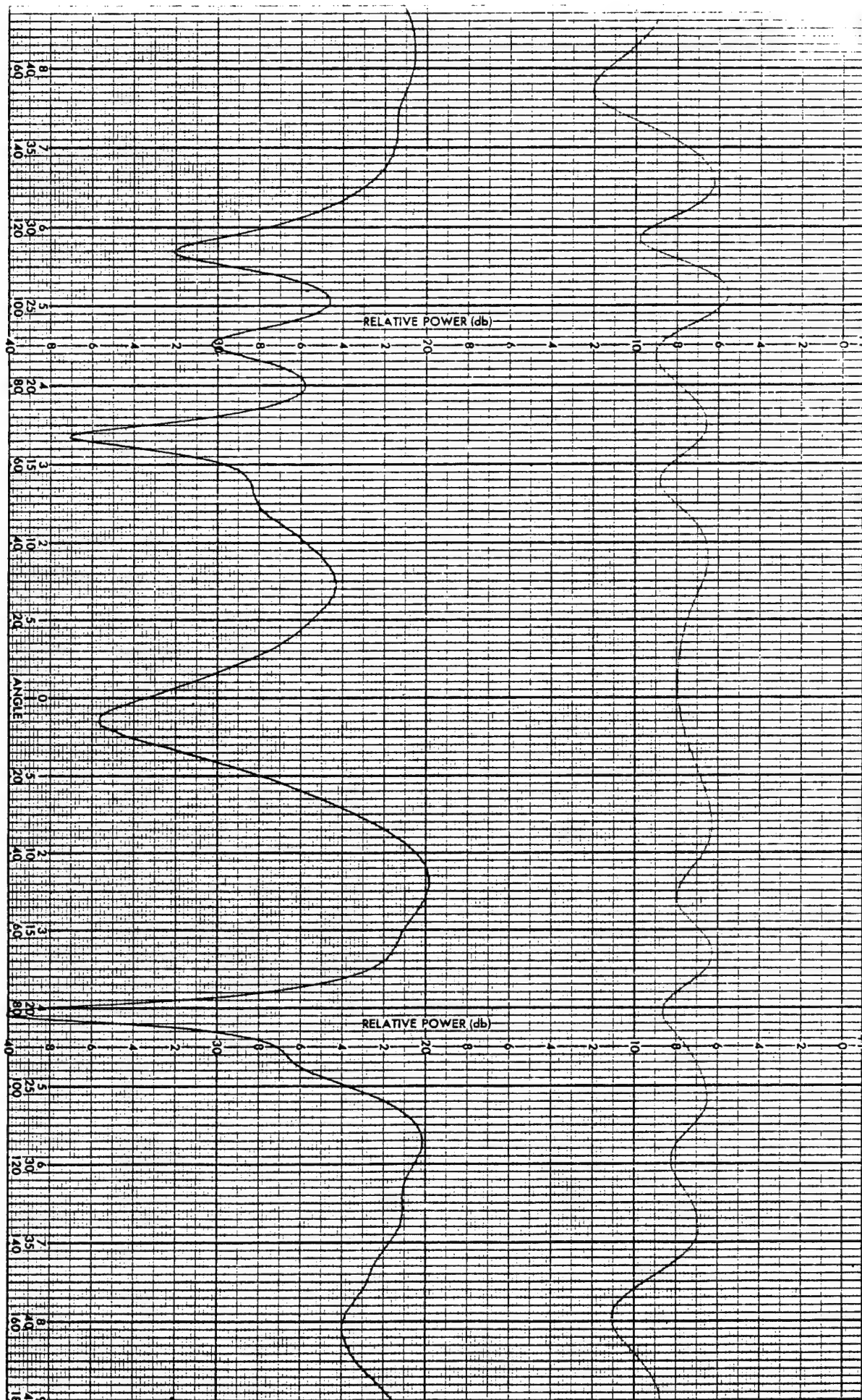
Cellular 90° 4 Bowtie
880 MHz

ENGR MU

B1-Ha

DATE 12-11-92

A-10 106744



PROJECT
REMARKS

Cellular 90° & Bowtie
870 MHz

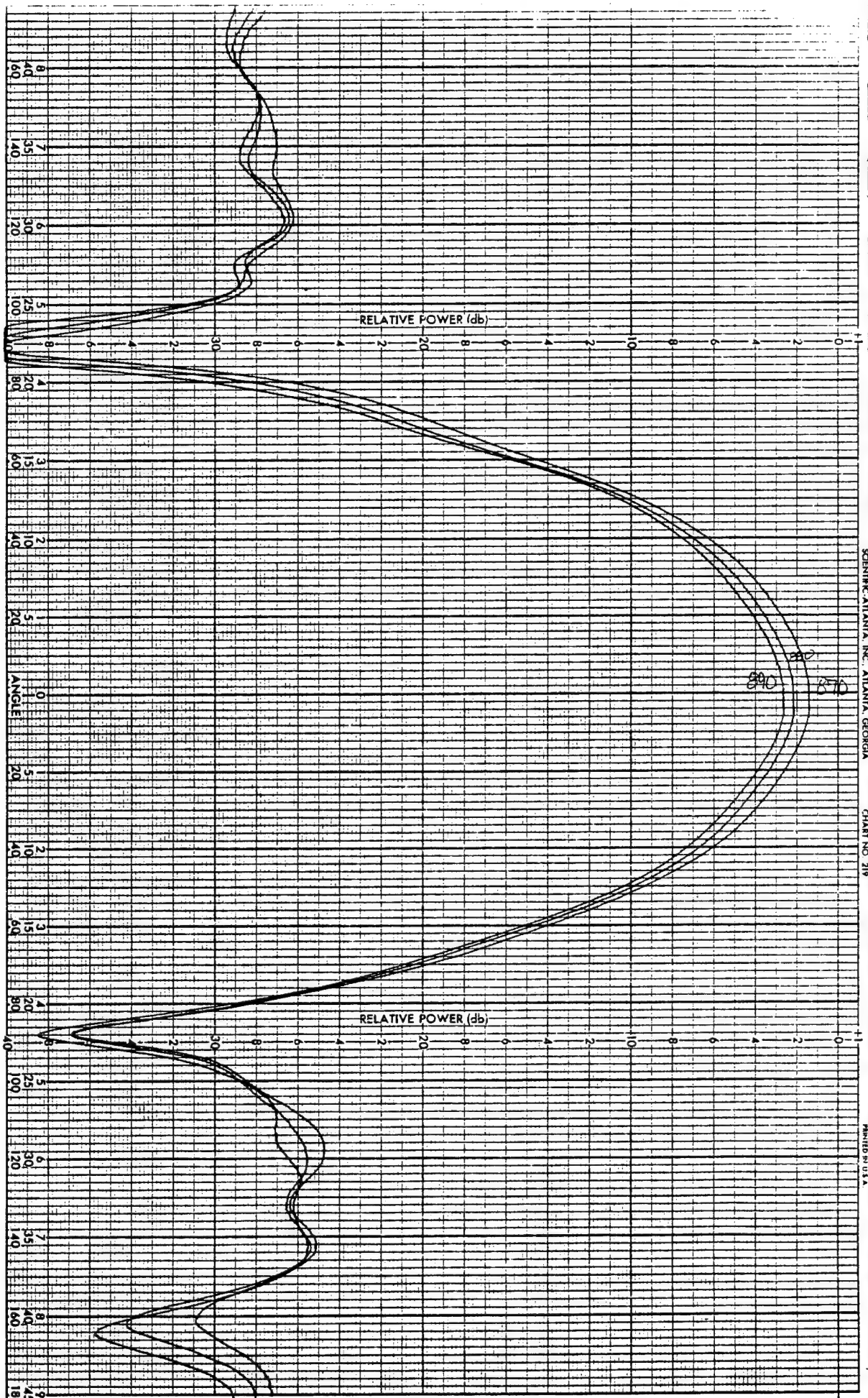
ENGR

M^o
Bl = Hon

DATE

12-11-92

A=10 106745



SCIENTIFIC ATLANTA, INC., ATLANTA, GEORGIA
CHART NO. 219
PRINTED IN U.S.A.

PROJECT
REMARKS

ENGR

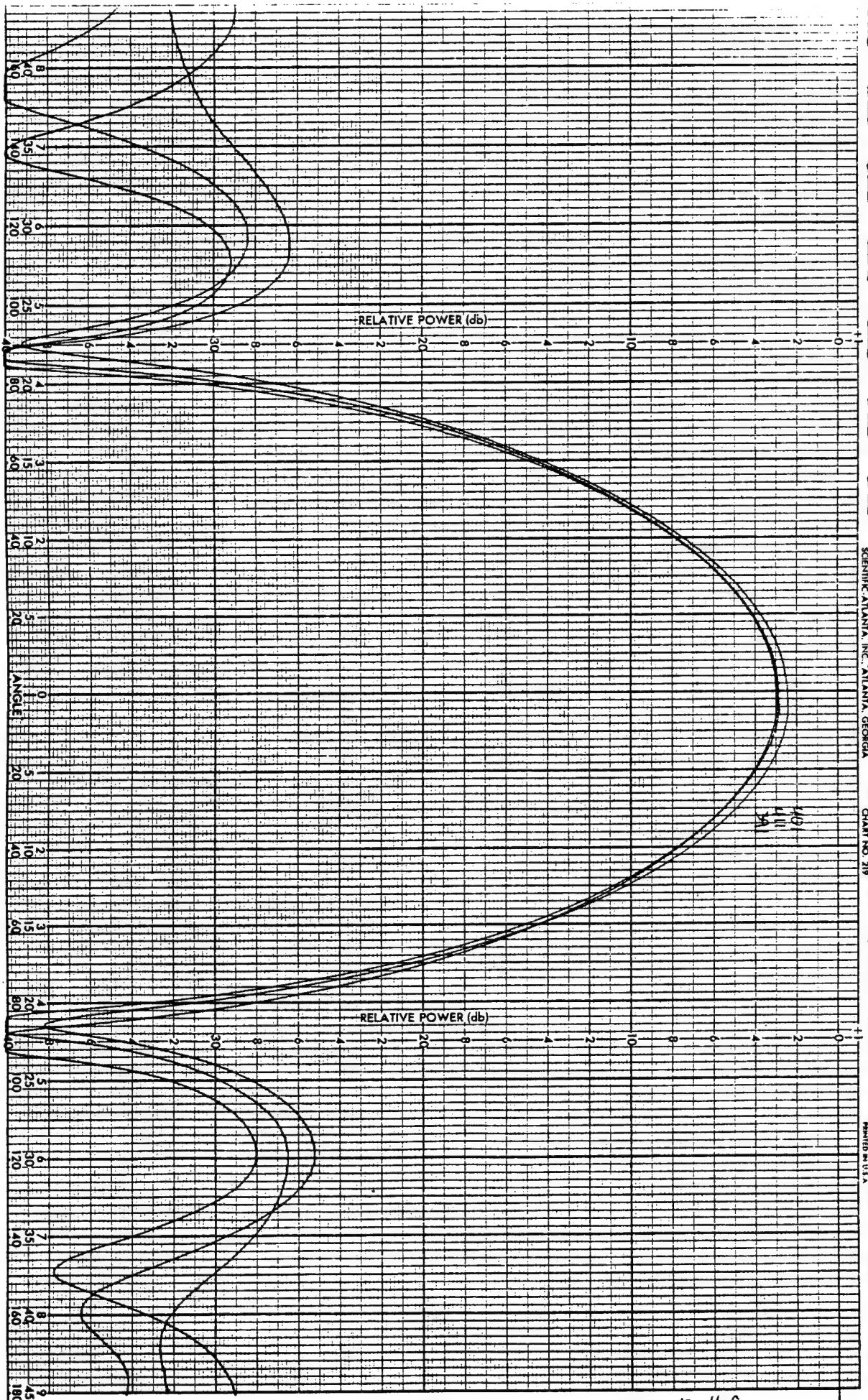
+10.0db

DATE

12-11-92

Post ~~Delta~~ Cross Log Coars

A=0 106746



SCIENTIFIC ATLANTA, INC., ATLANTA, GEORGIA
 CHART NO. 318
 REVISED 11-1-74

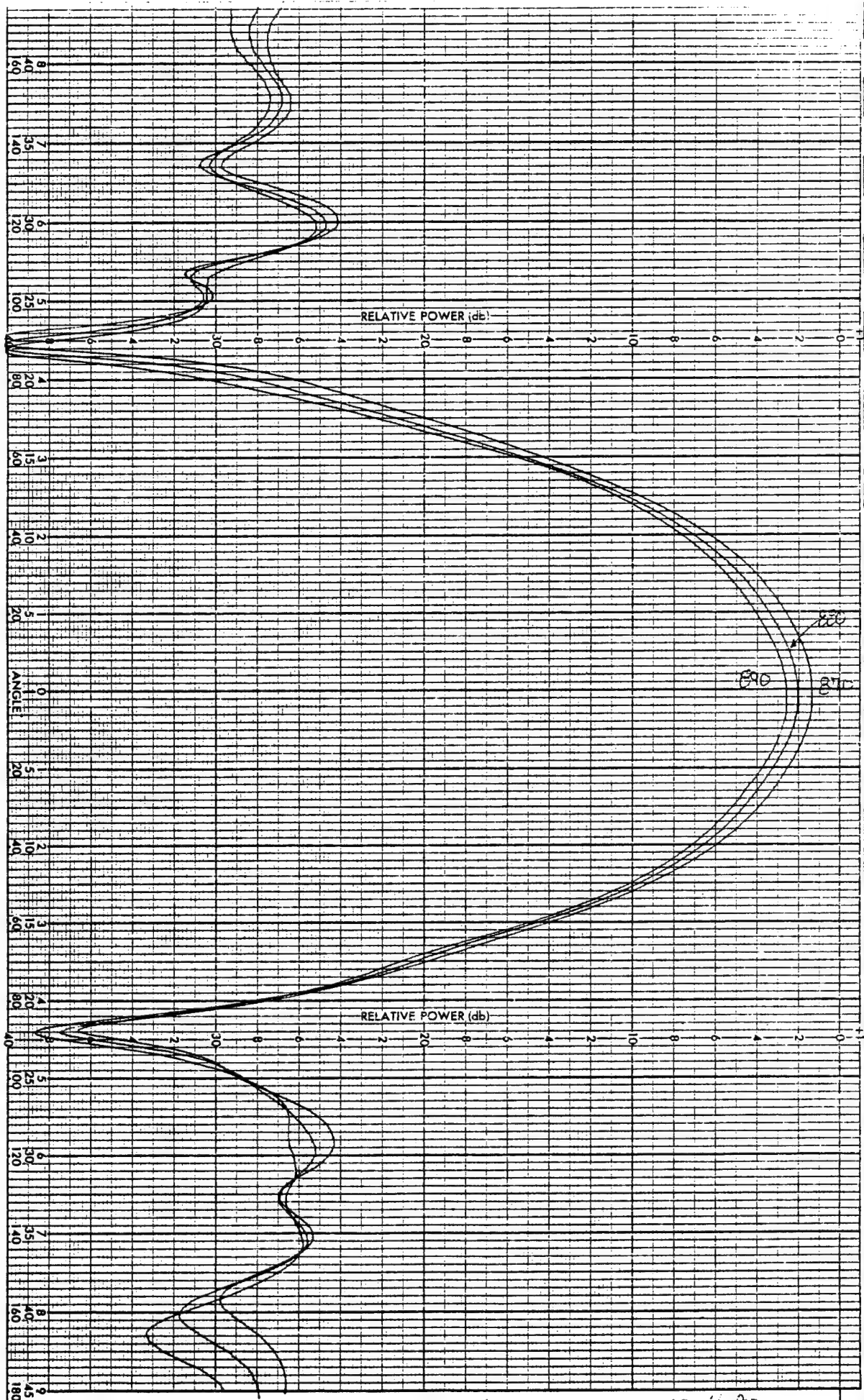
PROJECT
 REMARKS

ENGR

DATE 12-11-92

Post Cross Coa Charns

106747



PROJECT
REMARKS

Cellular

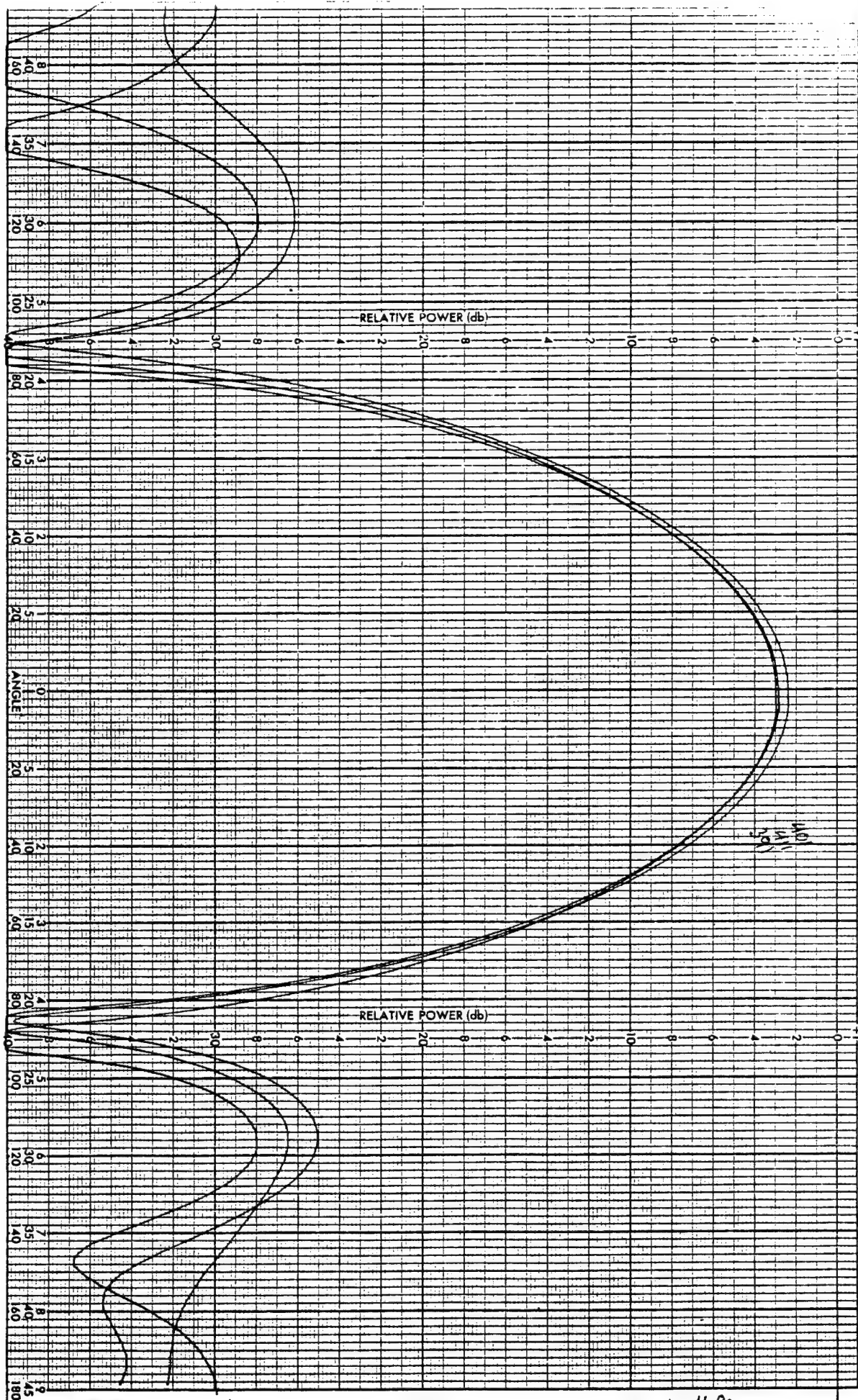
ENGR

Hor.

DATE

12-11-92

107159



PROJECT
REMARKS

Argos
Cross 100 std Grain

ENGR

Hor

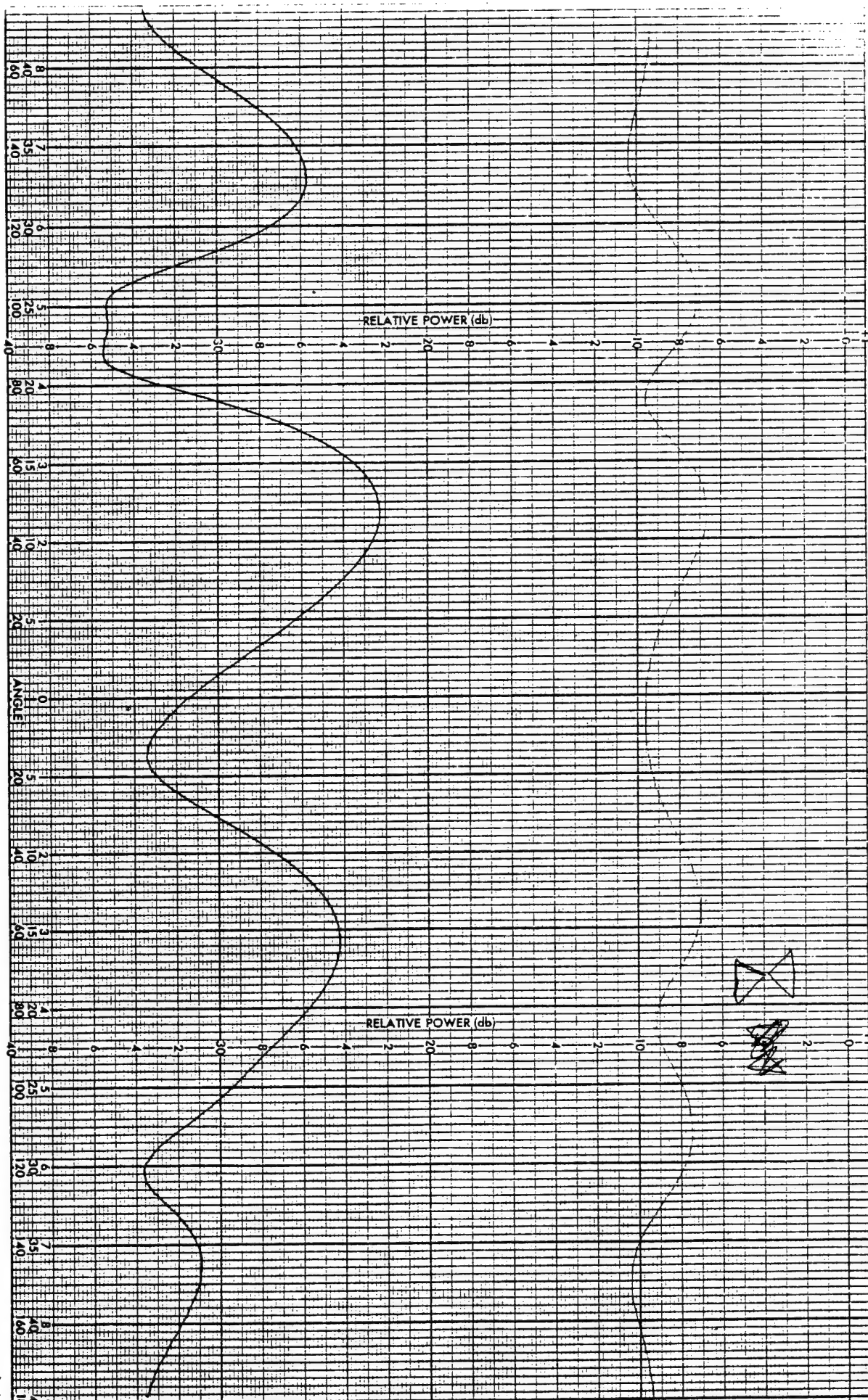
DATE 12-11-92

4-20 107161

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CHART NO. 20

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SCIENTIFIC ATLANTA, INC., ATLANTA, GEORGIA

CHART NO. 219

PRINTED IN U.S.A.

PROJECT
REMARKS

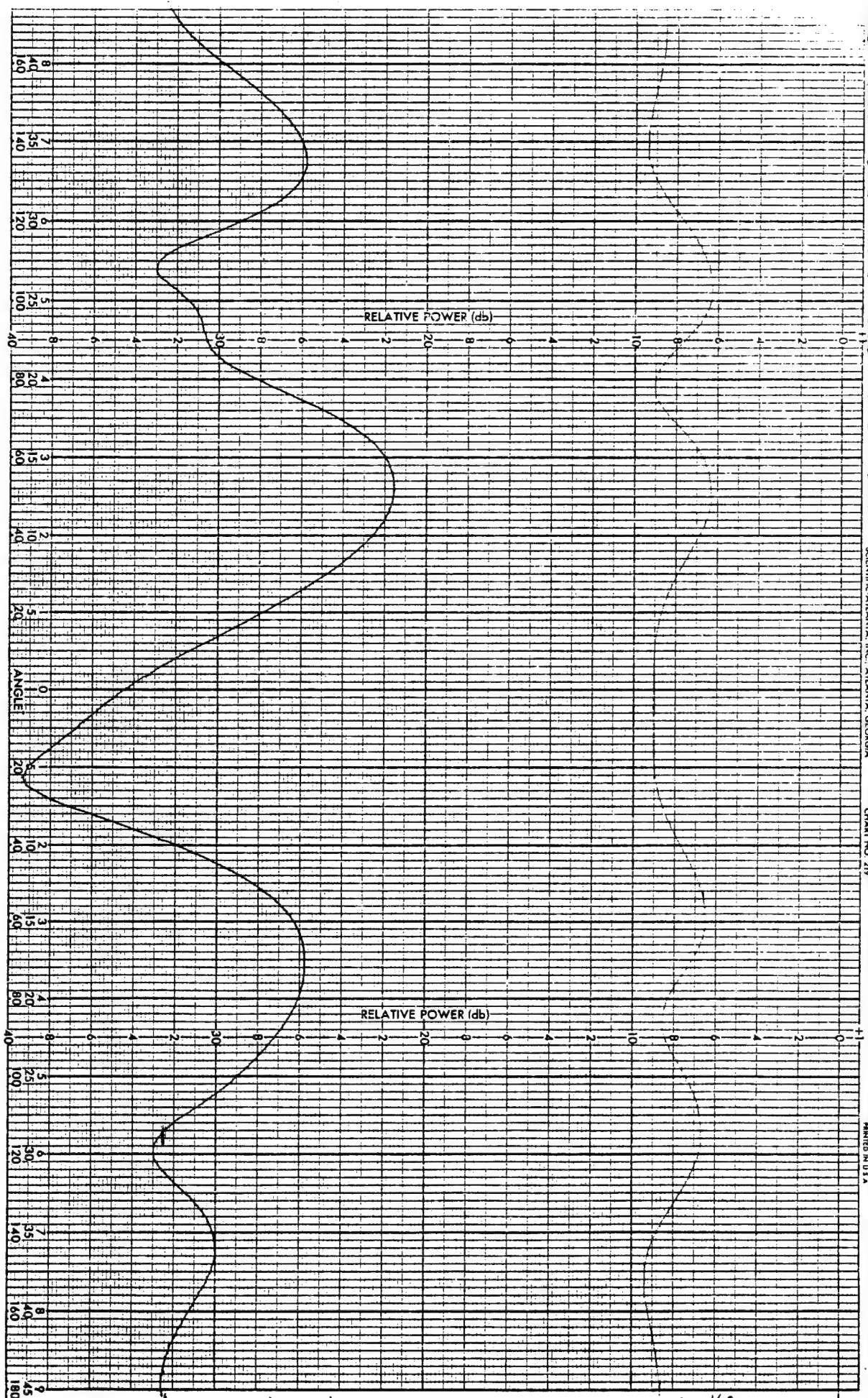
Argos 90° & Dotwire
391MHz

ENGR

B1=Hr

DATE 12-11-92

A=20 107162



PROJECT
REMARKS

Argos 90° X Dowie
401MHz

ENGR

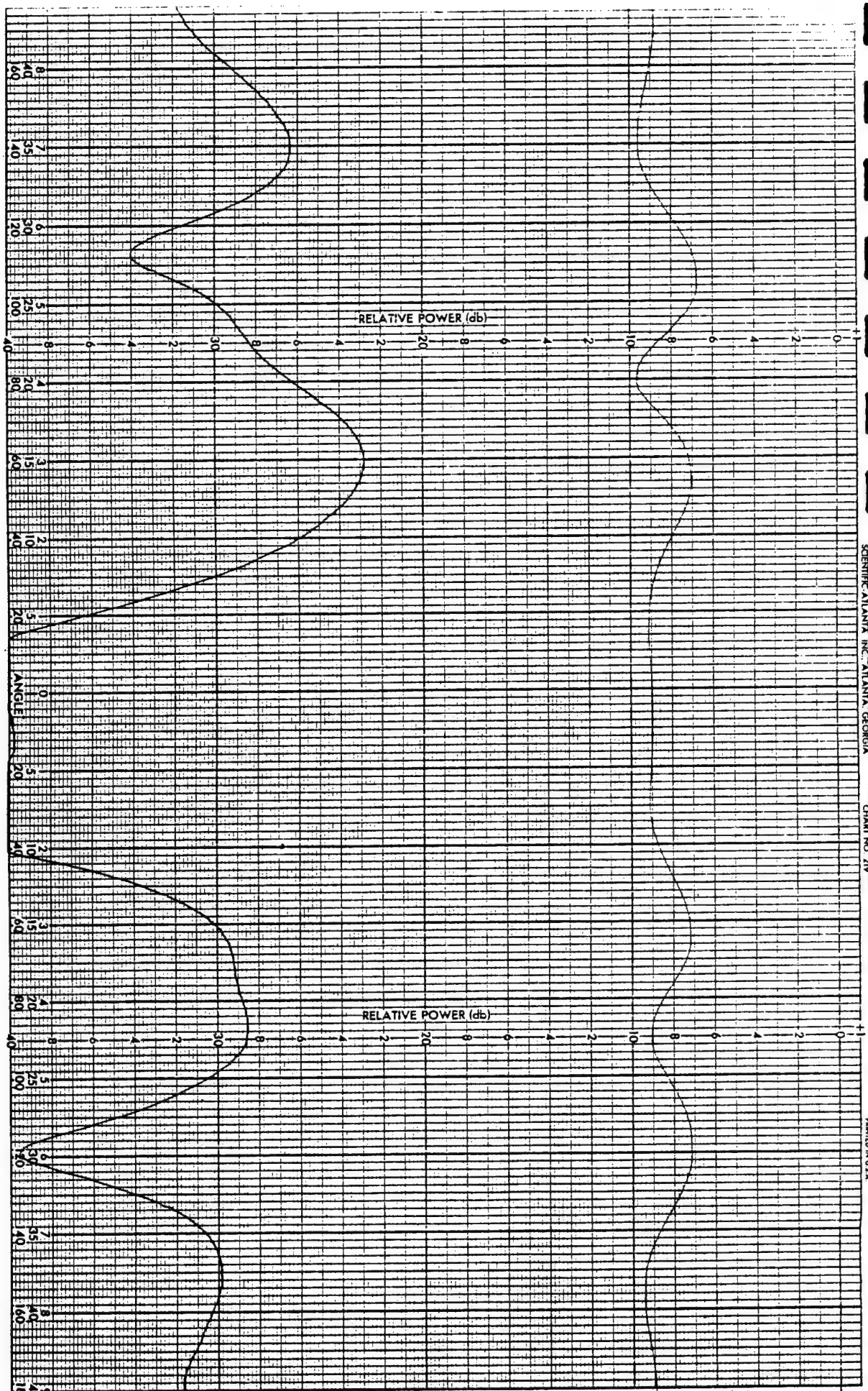
B1=40m

DATE

12-11-92

A=20

107163



SCIENTIFIC ATLANTA, INC., ATLANTA, GEORGIA
 CHART NO. 119
 PRINTED IN U.S.A.

PROJECT
 REMARKS

Argos 90° X Bowtie
 411 MHz

ENGR

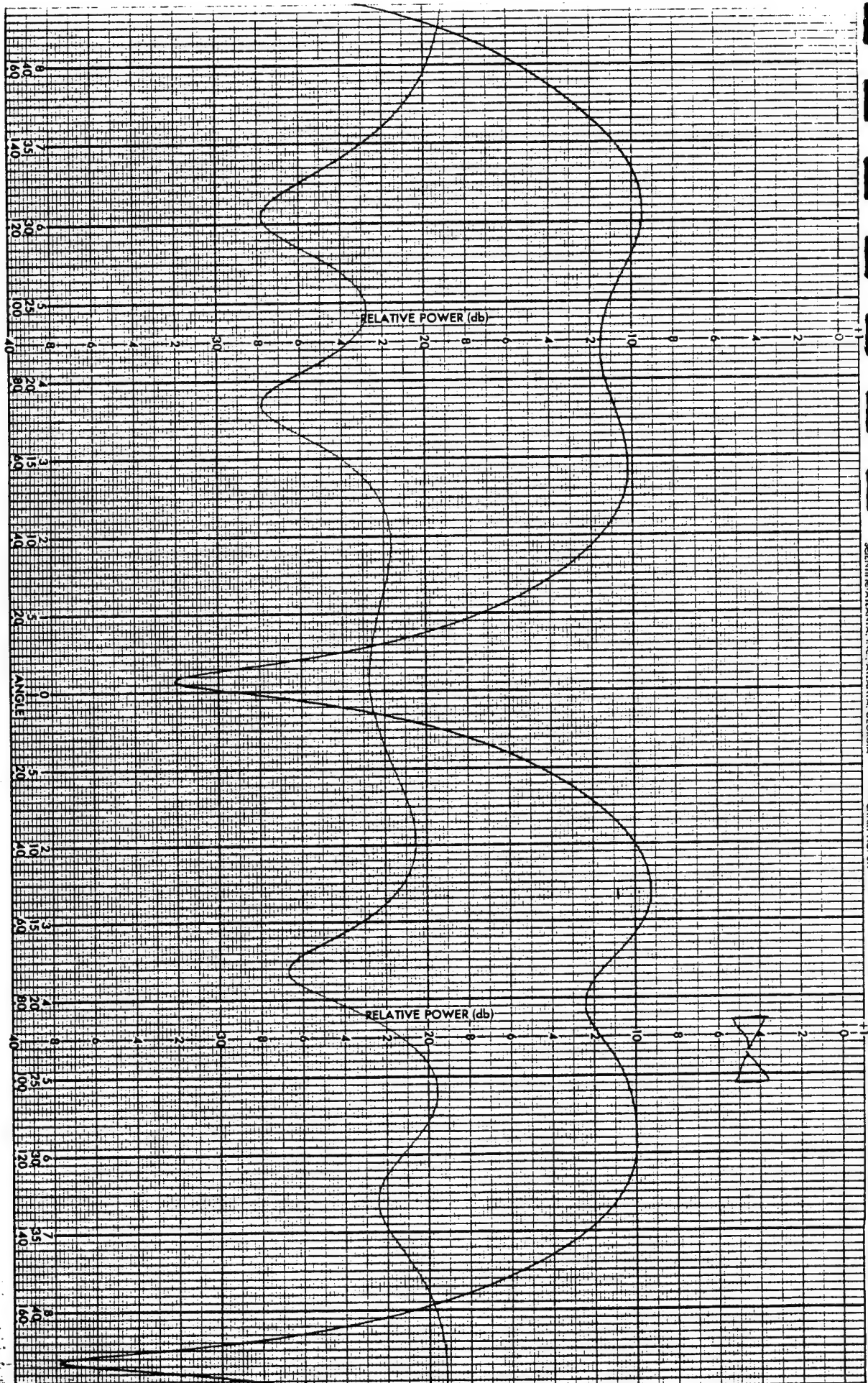
Bl = Hm

DATE

12-11-92

A=20

107164



PROJECT
REMARKS

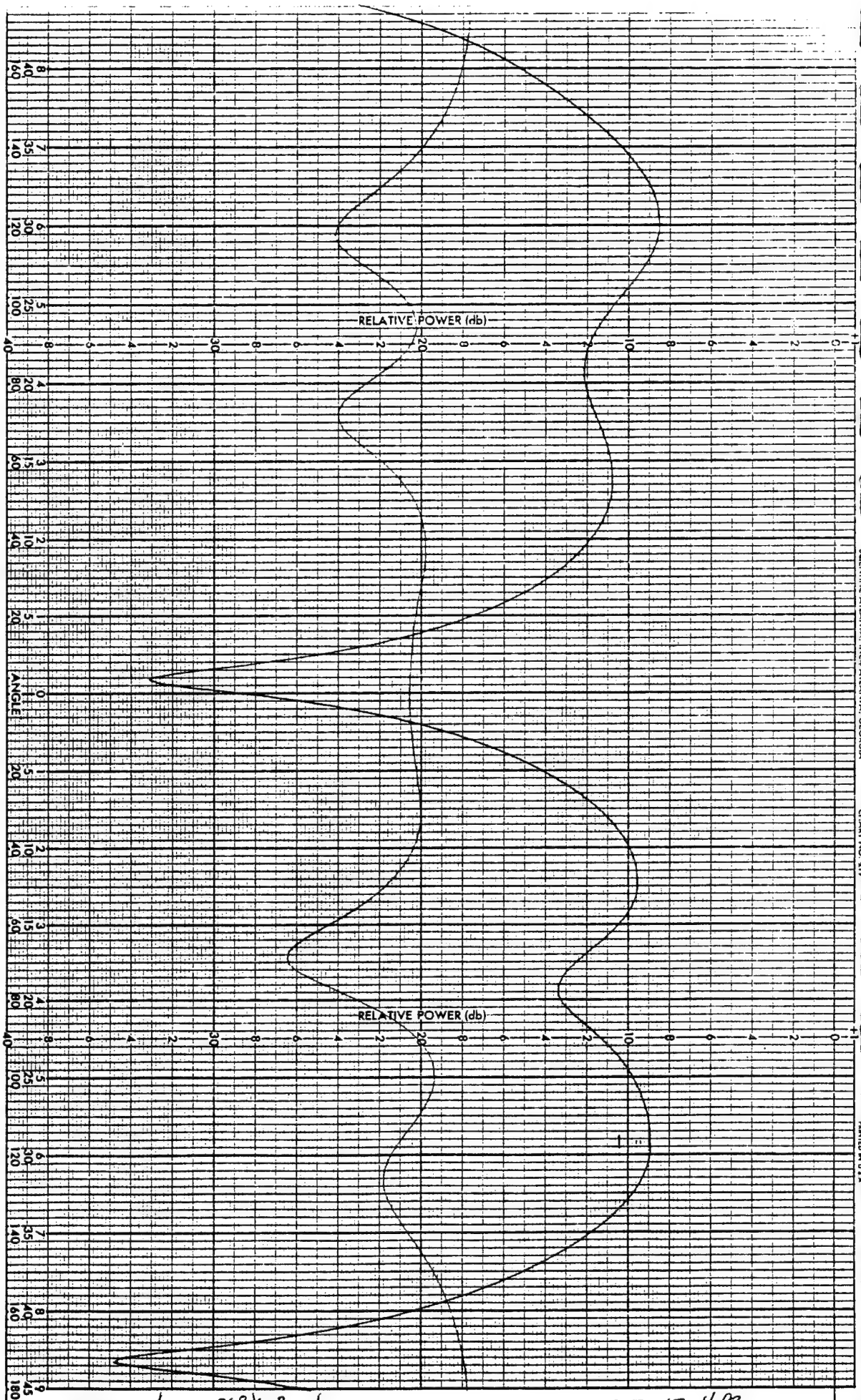
Argos 90° & Bowtre
411MHz

ENGR

B1-Hor

DATE 12-11-92

A=20 107165



PROJECT
REMARKS

Argos 90° Bowtie
40 MHz

ENGR

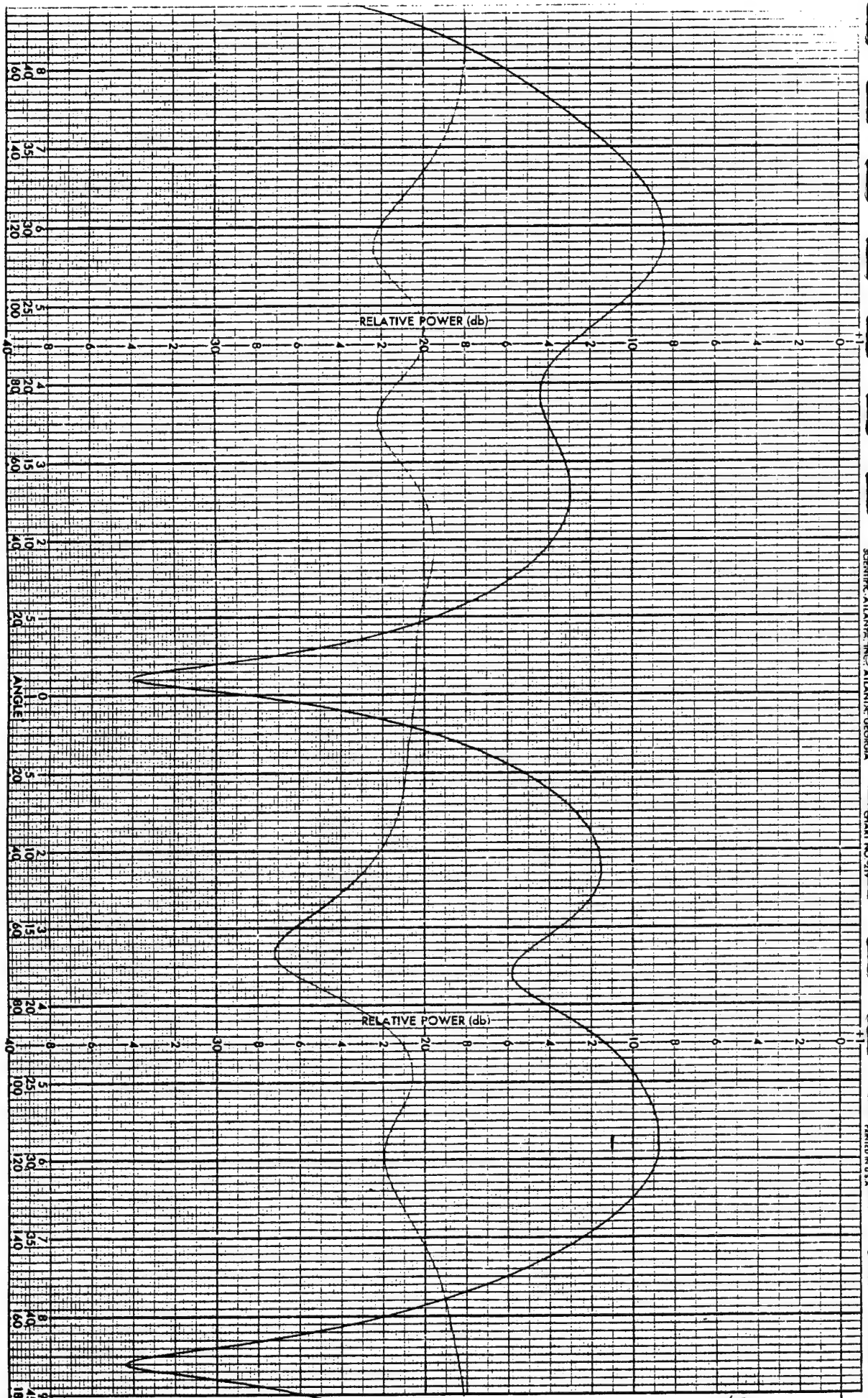
B/-Hm

DATE

12-11-92

A=20

107166



PROJECT
REMARKS

Argos 90° & Downtie
39/MAR

ENGR

DI=1/10

DATE 12-11-92

1-20 107167

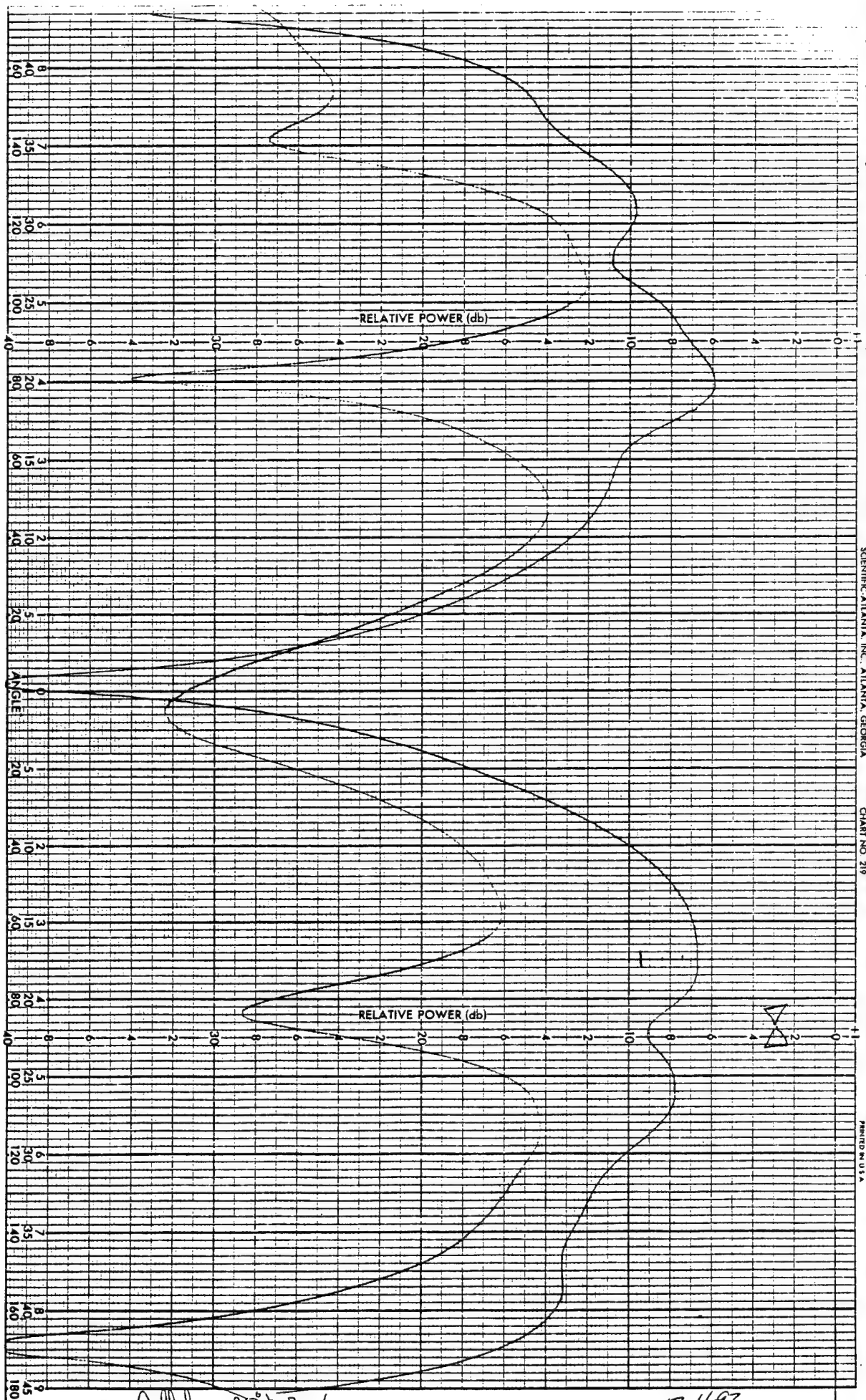


Appendix III

Cellular Bowtie Antenna

Cellular 90° Point Antennas

Freq	SGH LPA on chart	OBS on chart	H	Gain (dBi) V
870	-1.4	-9.4	+2.7	-9.8
880	-2.2	-10.2	+3.0	-9.8
890	-2.6	-10.6	+3.0	-9.4



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PROJECT
REMARKS

Cellular 90° Bowtie
870 MHz

ENGR

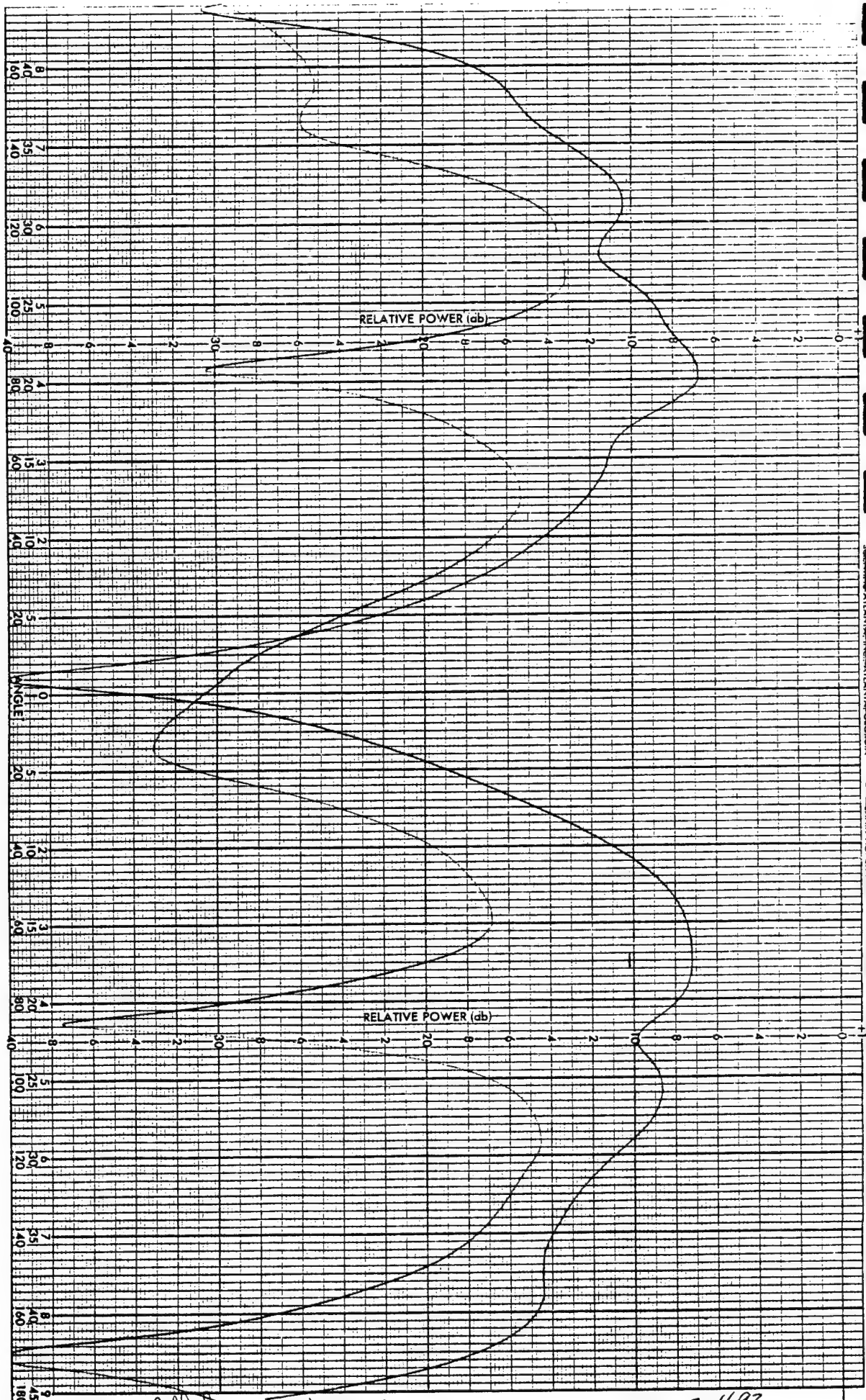
BI-Hor

DATE

12-11-92

A-10

107168



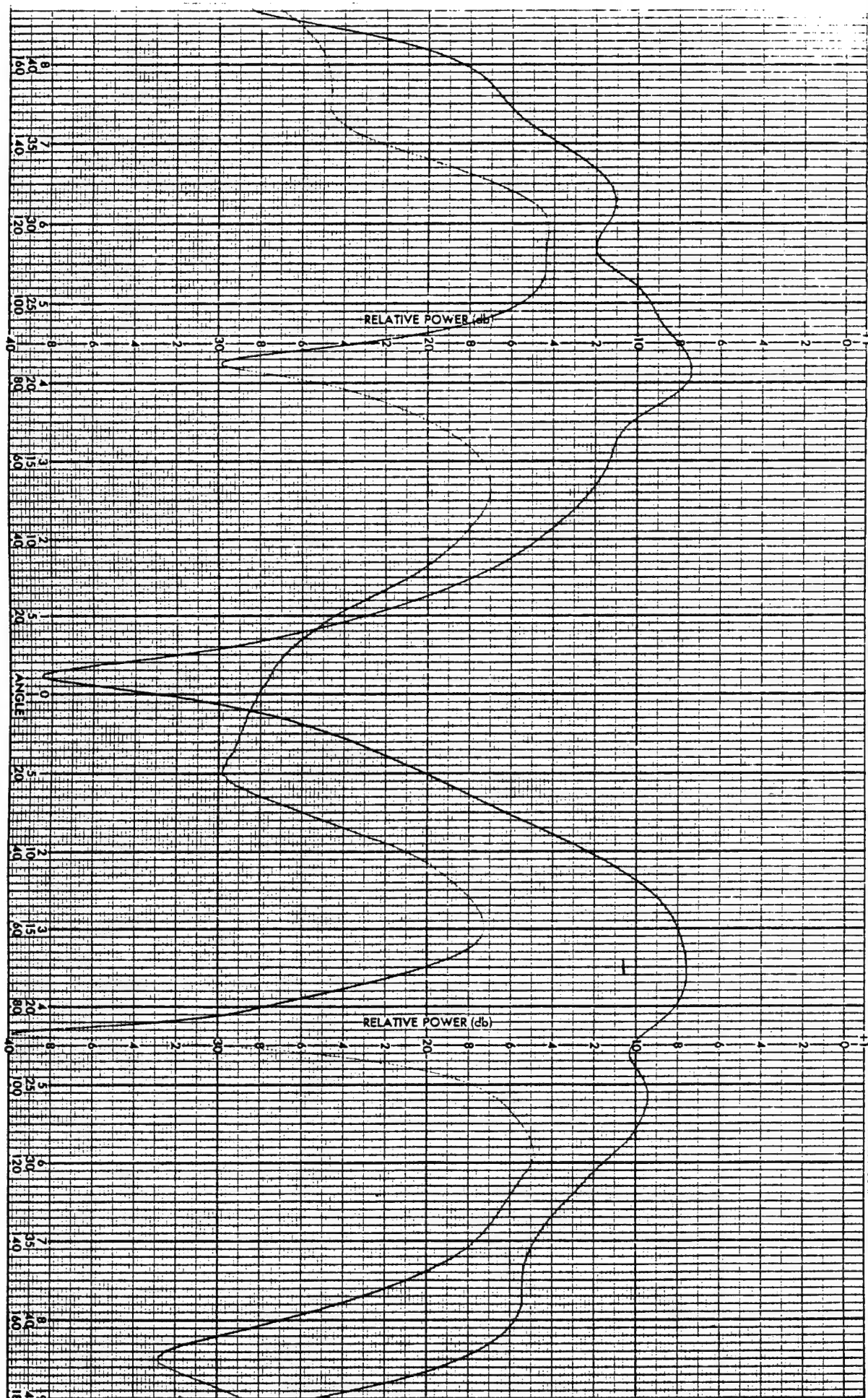
PROJECT
REMARKS

Cellular 90° & Bowtie ENGR
880 MHz

B1/Hon

DATE 12-11-92

A=10 107169



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PRINTED IN U.S.A.

PROJECT
REMARKS

Cellular 90° & Bentie
890MHz

ENGR

D1-Hen

DATE

12-11-92

A-11 107170



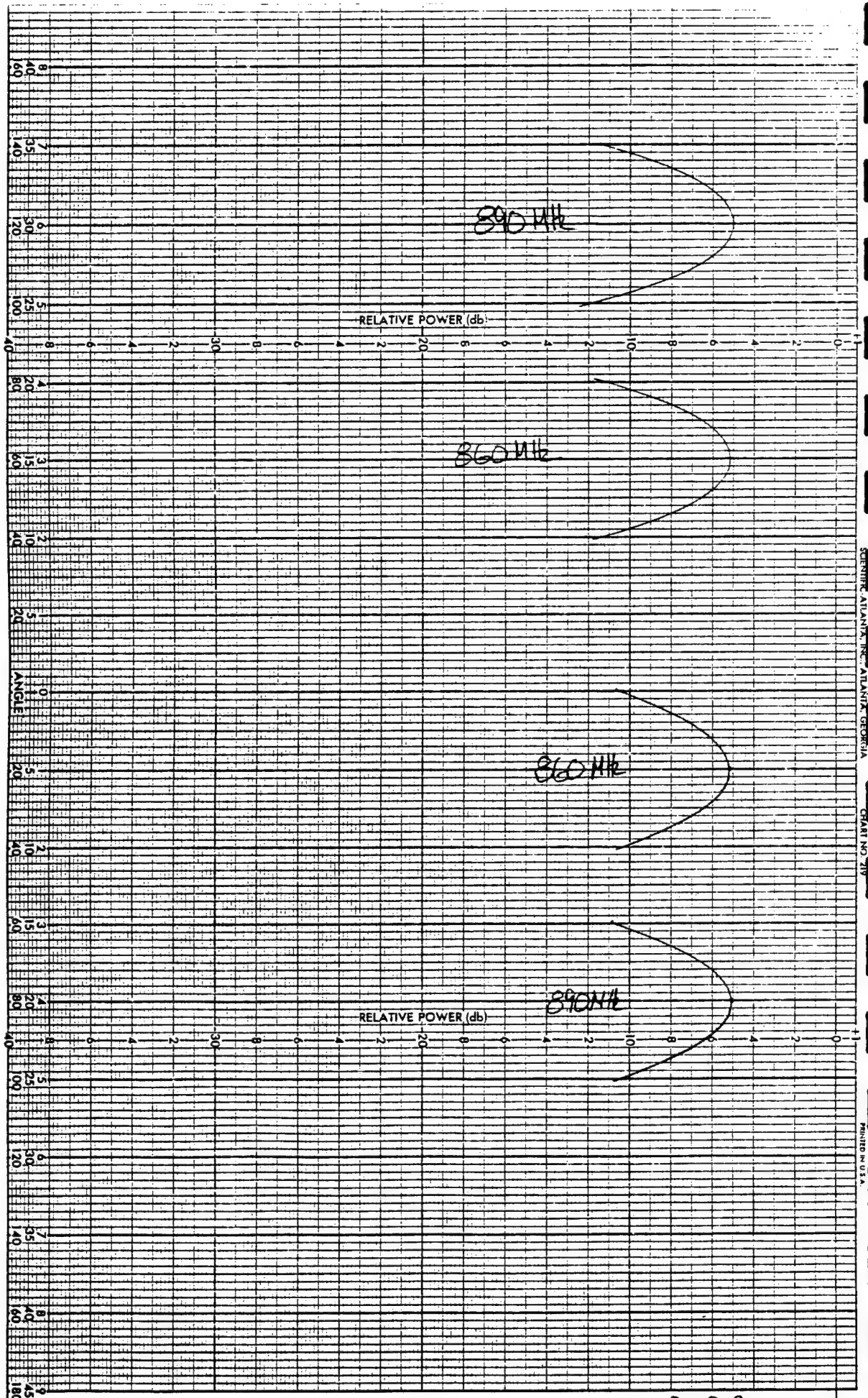
Appendix IV

Cellular Bent Monopole Antenna

Freq	SGH dBIC	SGH measured		OdBIC on chart		EQ 0° gain		AZ	0° gain
		Hor	Ver	Hor	Ver	Hor	Ver		
860	15.4	-5.3	-5.2	-10.7	-10.6	-25.1	3.15	3.20	-24.6
890	15.7	-5.15	-5.1	-10.85	-10.8	-24.05	2.15	2.25	-24.5

Cellular Bow Tie (30°)

Freq	SGH dBIC	SGH measured		OdBIC on chart		EQ 0° gain		AZ 90° gain	
		Hor	Ver	Hor	Ver	Hor	Ver	Hor	Ver
860	15.4	-5.3	-5.2	-10.7	-10.6	-28.10	+1.65	1.30	-19.7
890	15.7	-5.15	-5.1	-10.85	-10.8	-23.05	+7.75	1.20	-18.0



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 CHART NO. 215
 PRINTED IN U.S.A.

PROJECT
 REMARKS

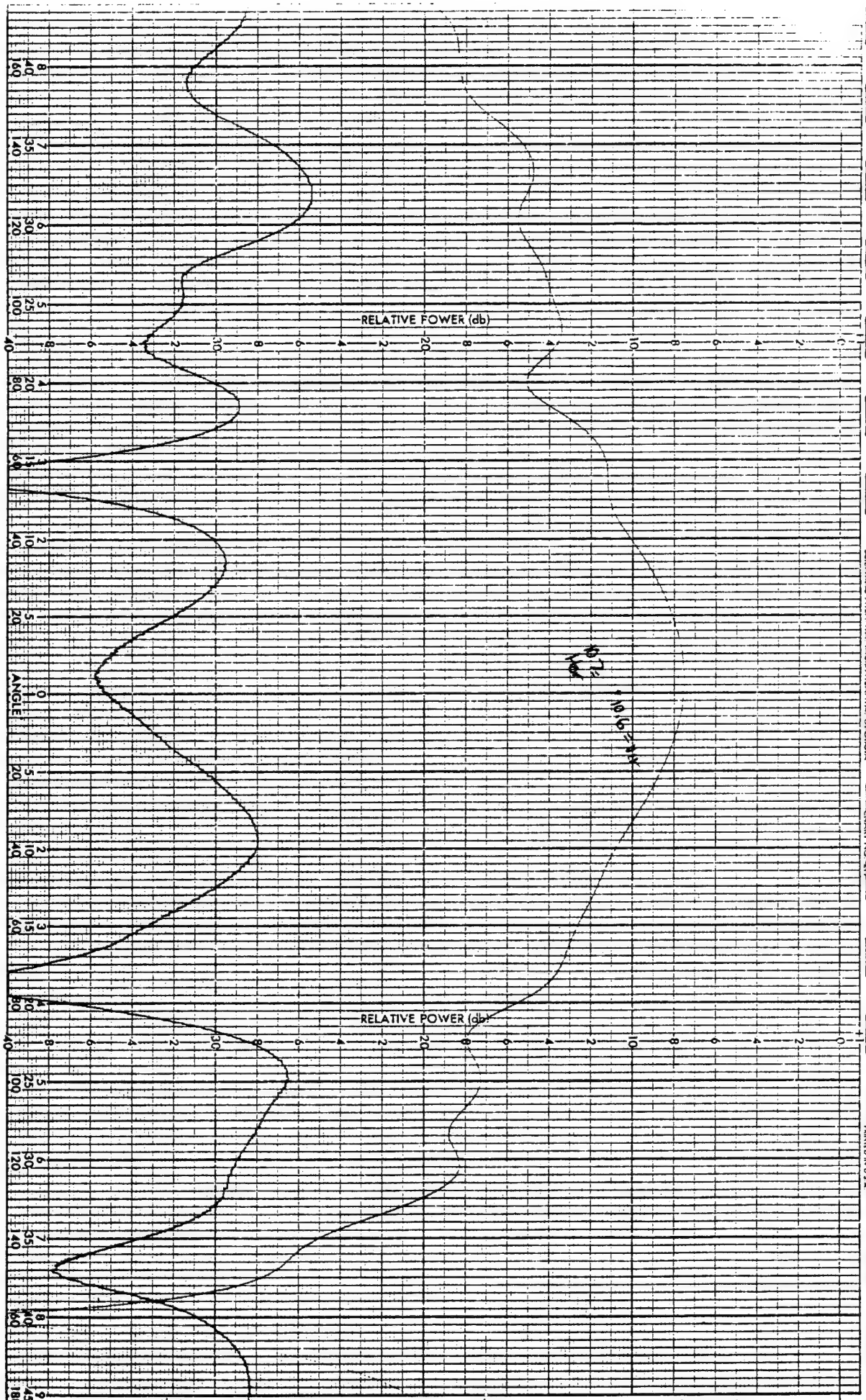
ENGR

DATE 10-28-91

Std Power 175 Worn

DI = Hor
 Red = Upr

A-70 215518



PROJECT
REMARKS

cellular bent monopole

960 MHz

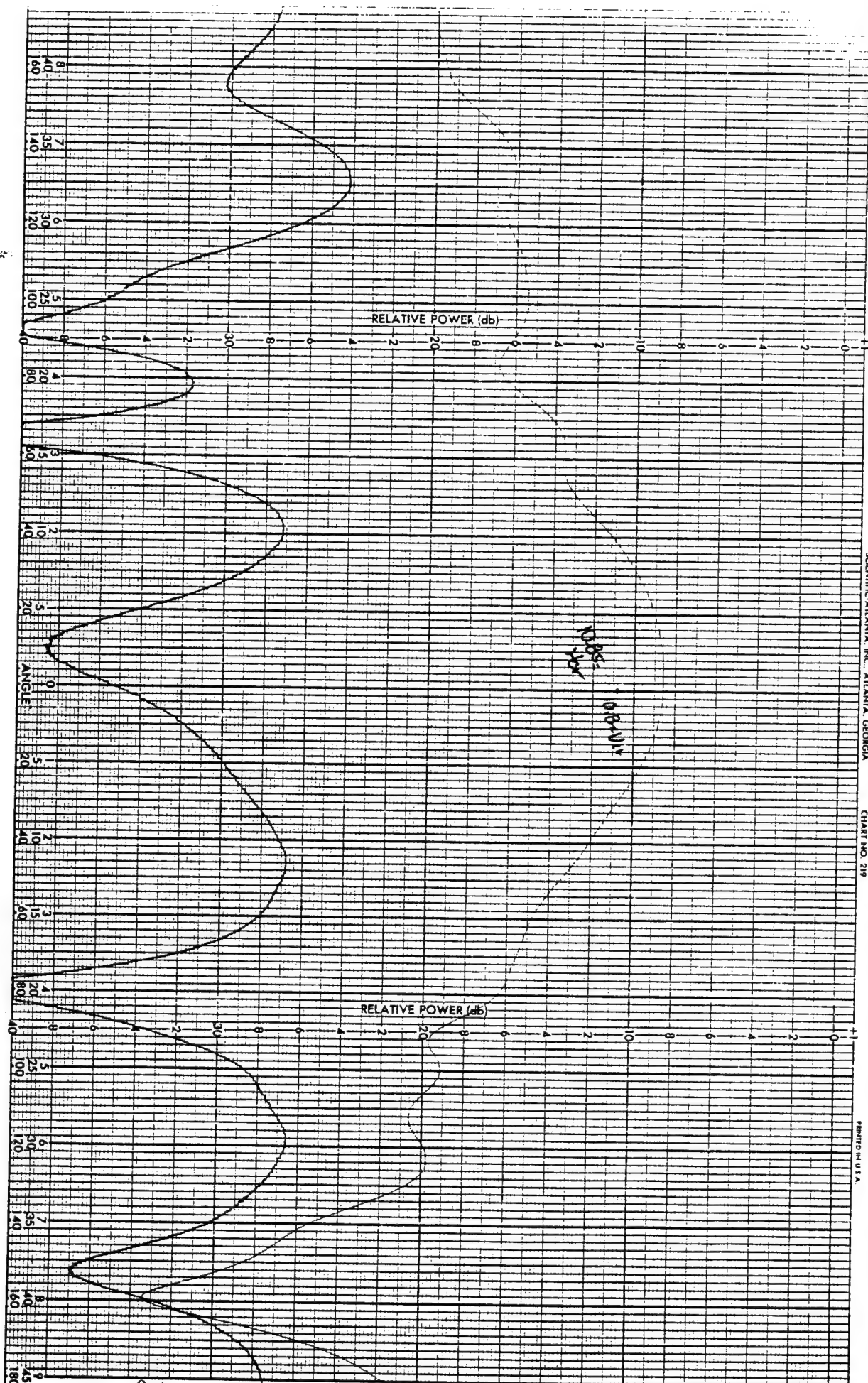
ENGR

AZ

B1 = 14m

DATE 10-28-92

A=10 215520



SCIENTIFIC ATLANTA, INC., ATLANTA, GEORGIA

CHART NO. 219

PRINTED IN U.S.A.

PROJECT
REMARKS

Cellular Bent Monopole

390 MHz

ENGR

A2

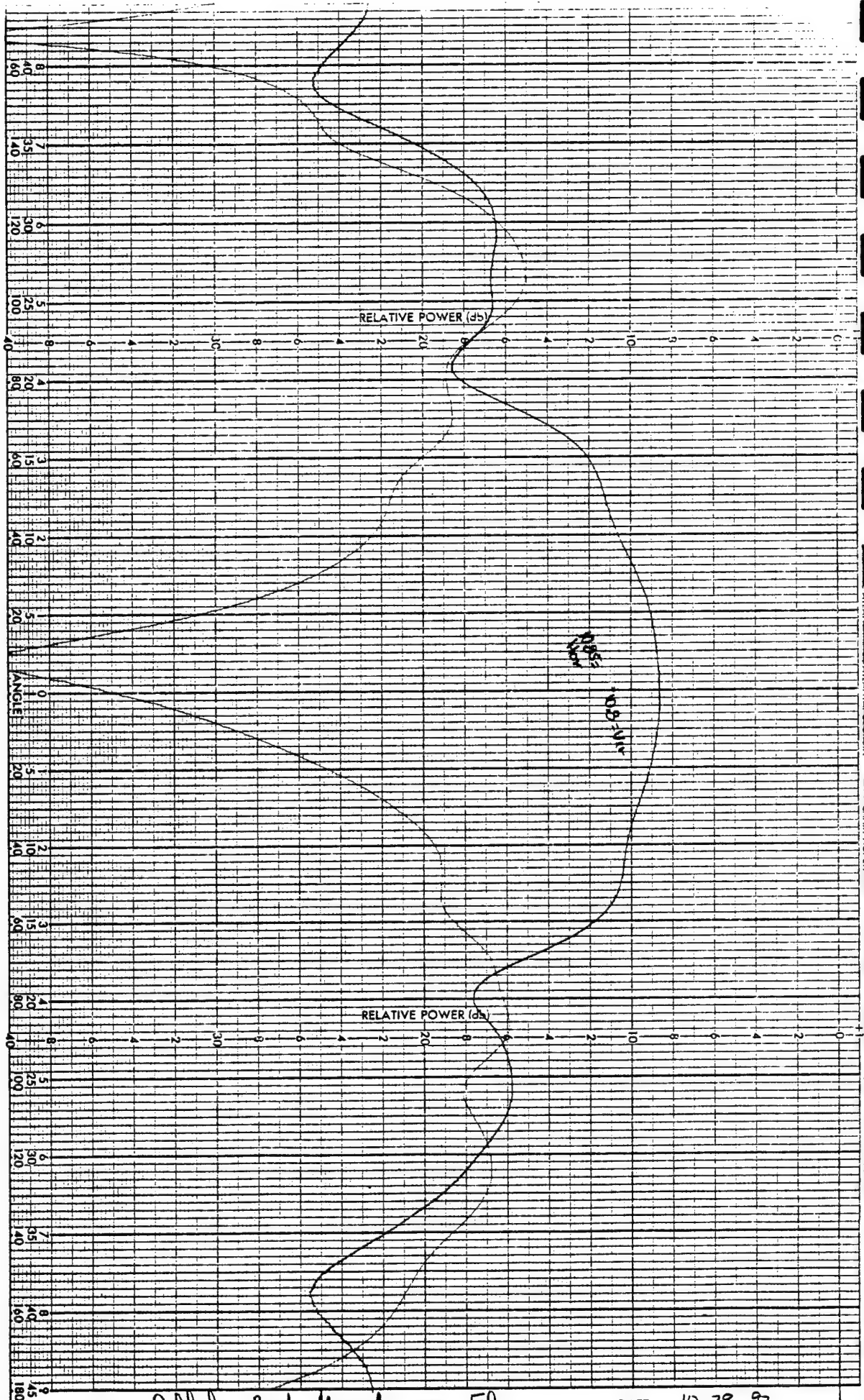
DATE

10-28-92

RI=14

1.10

215522



PROJECT
REMARKS

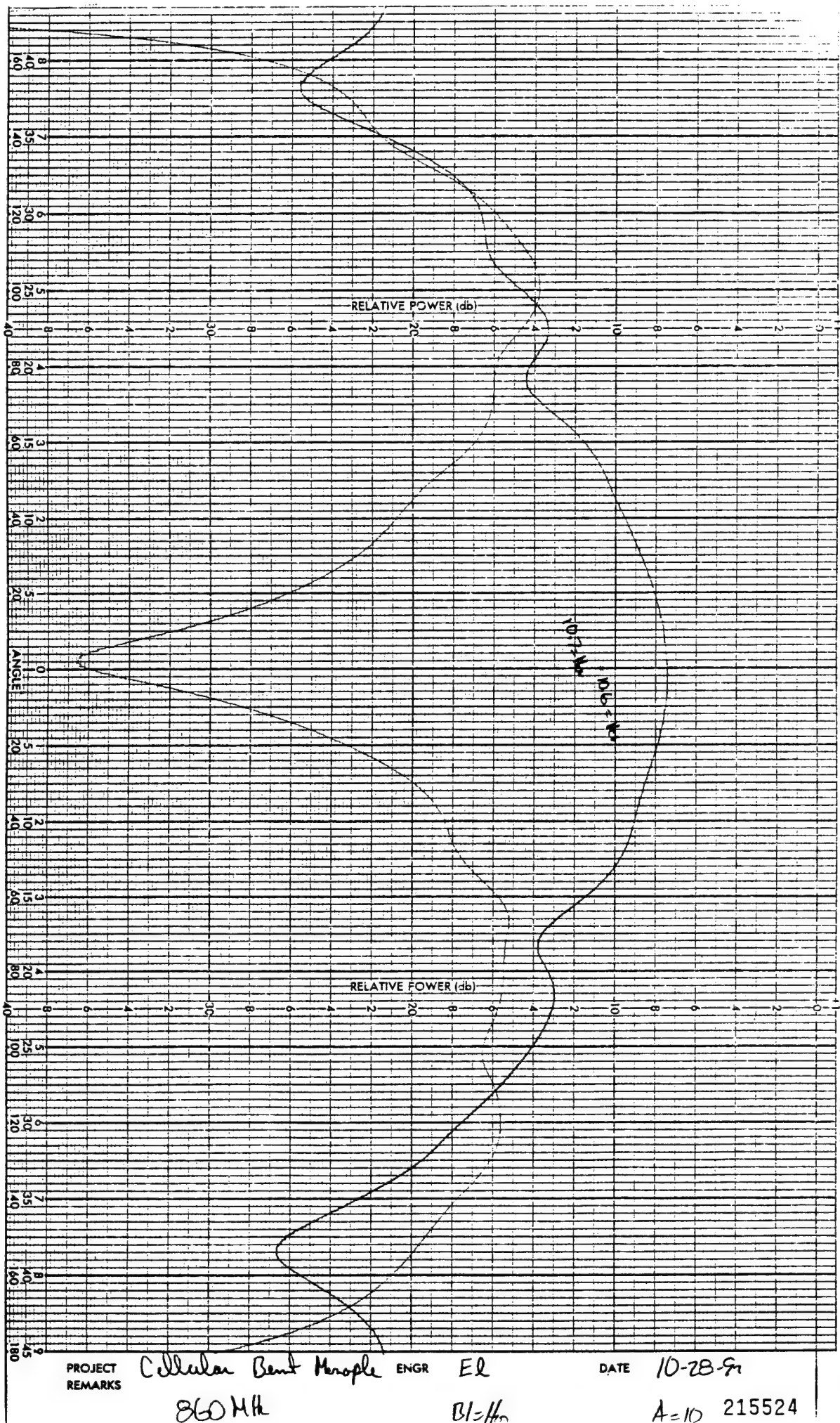
Cellular Base Monopole ENGR EL

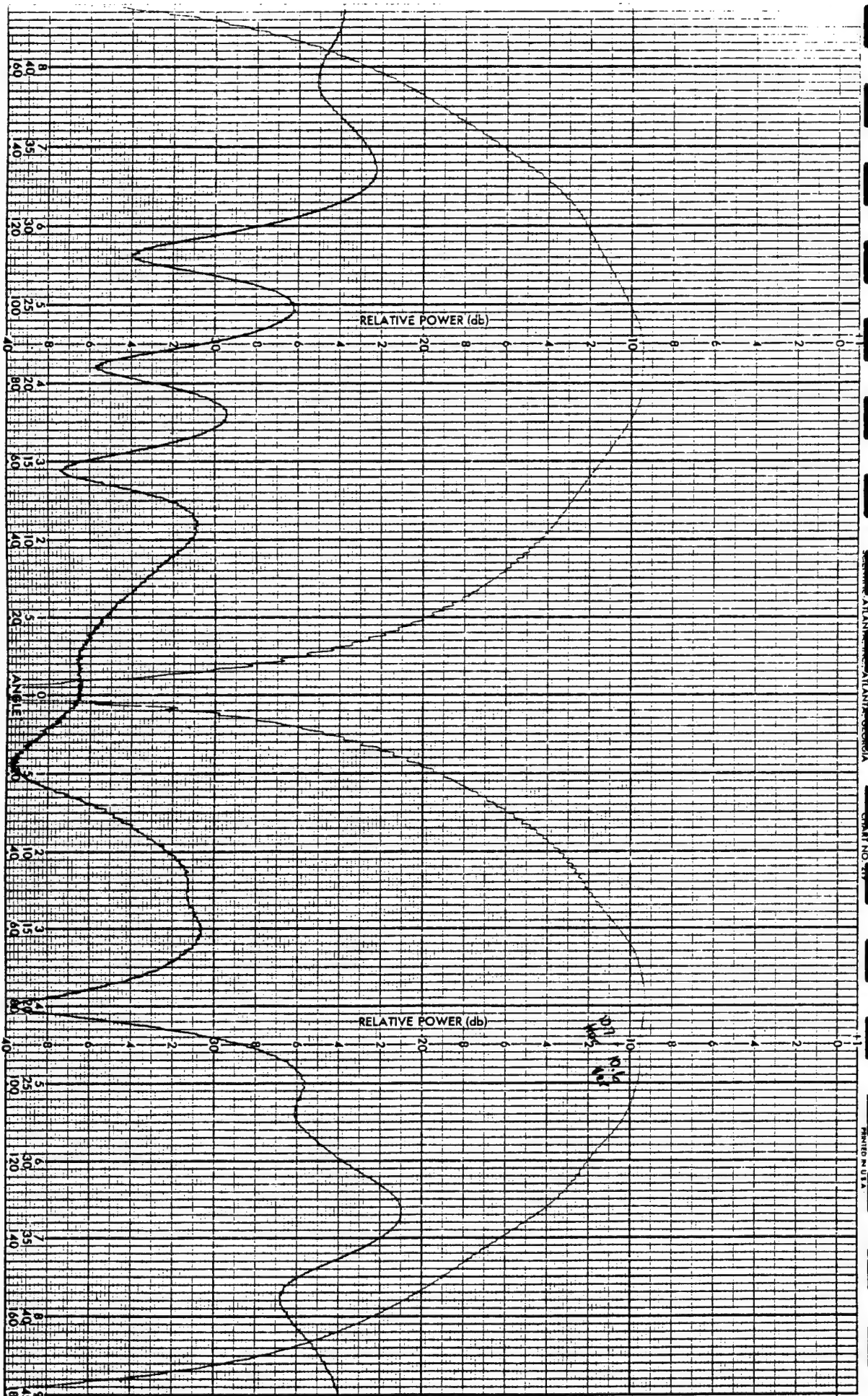
890 MHz

BI=H.

DATE 10-28-92

A-10 215523





PROJECT *Cellular Bow Tie*
REMARKS

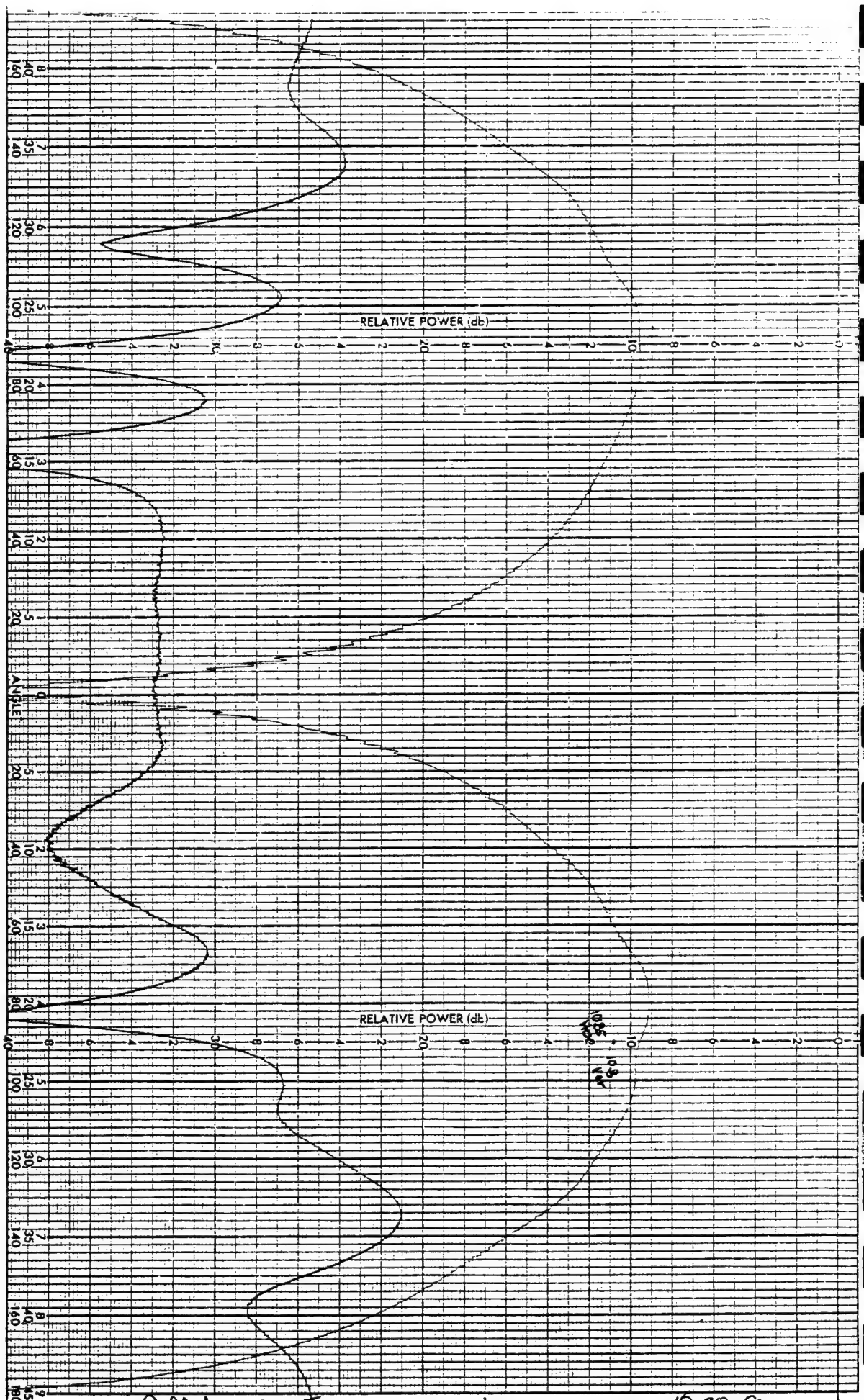
860 MHz

ENGR *A2*

B1-Hr

DATE *10-28-92*

A-10 215525



PROJECT
REMARKS

Cellular Bow Tie
890 MHz

ENGR

AZ

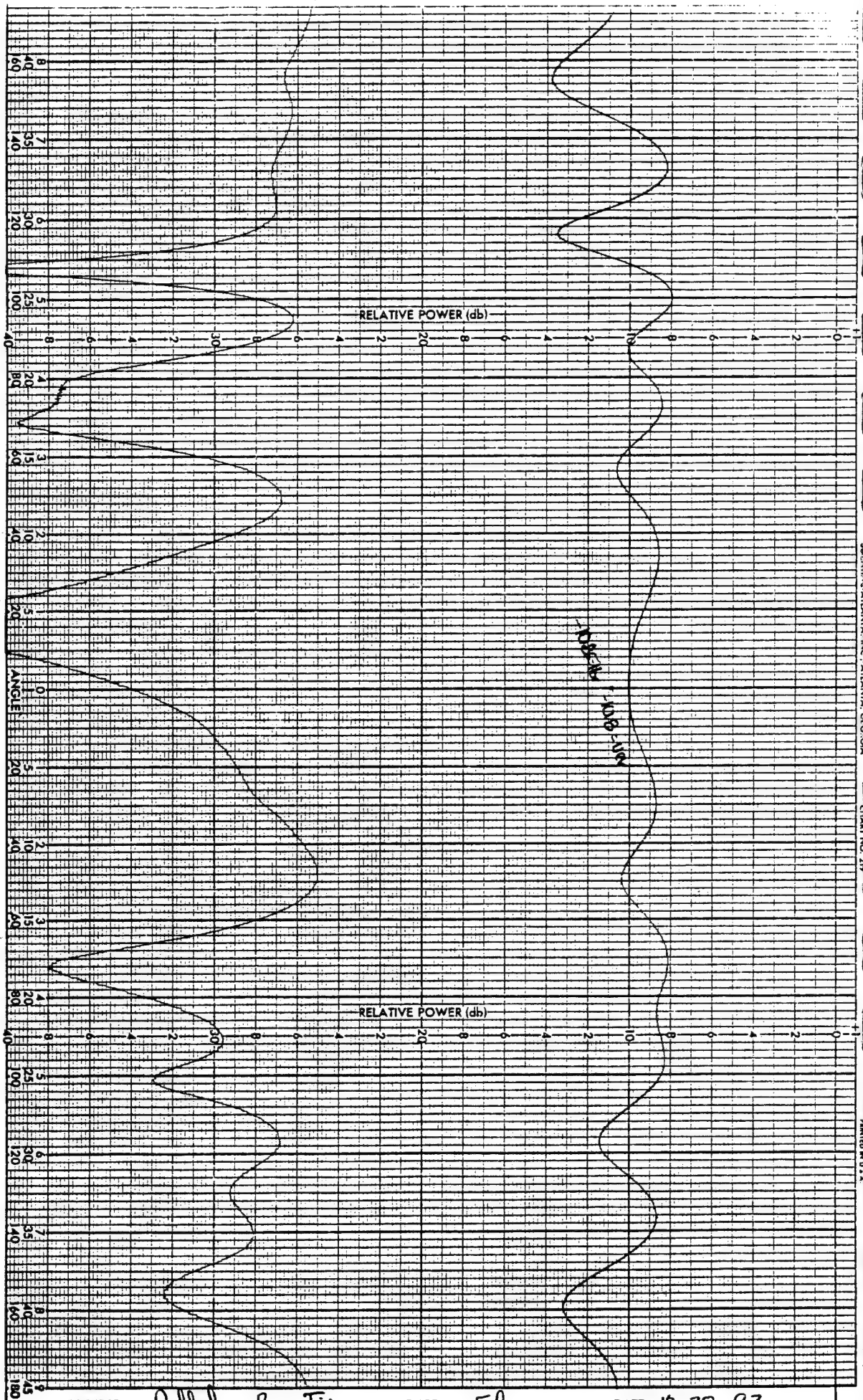
B1-H

DATE

10-28-92

A-10

215526



PROJECT
REMARKS

Cellular Bow Tie

ENGR

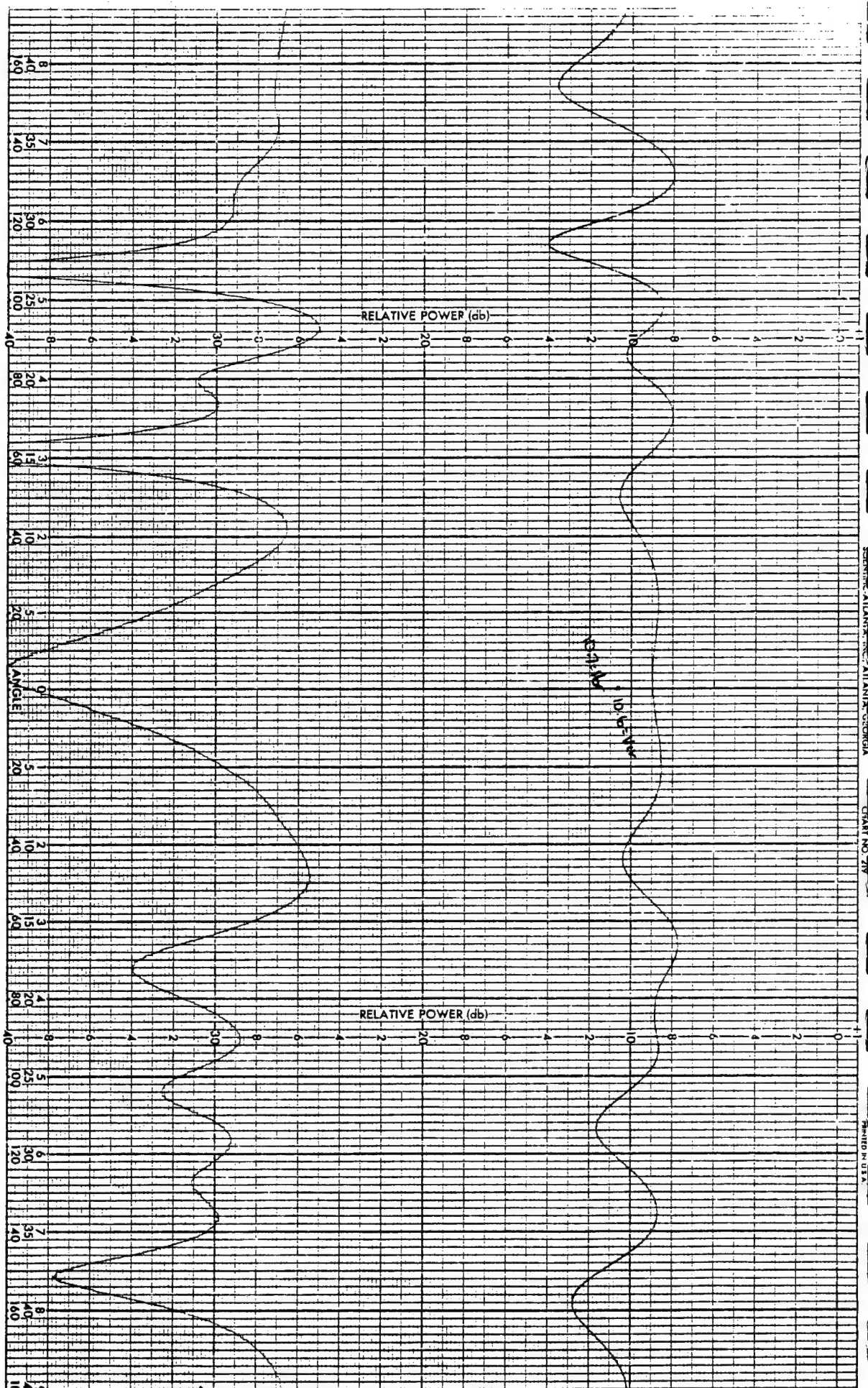
EL

DATE 10-28-92

890MHz

B1=H₀

A=10 215527



PROJECT
REMARKS

Cellular Bow Tie

ENGR

EL

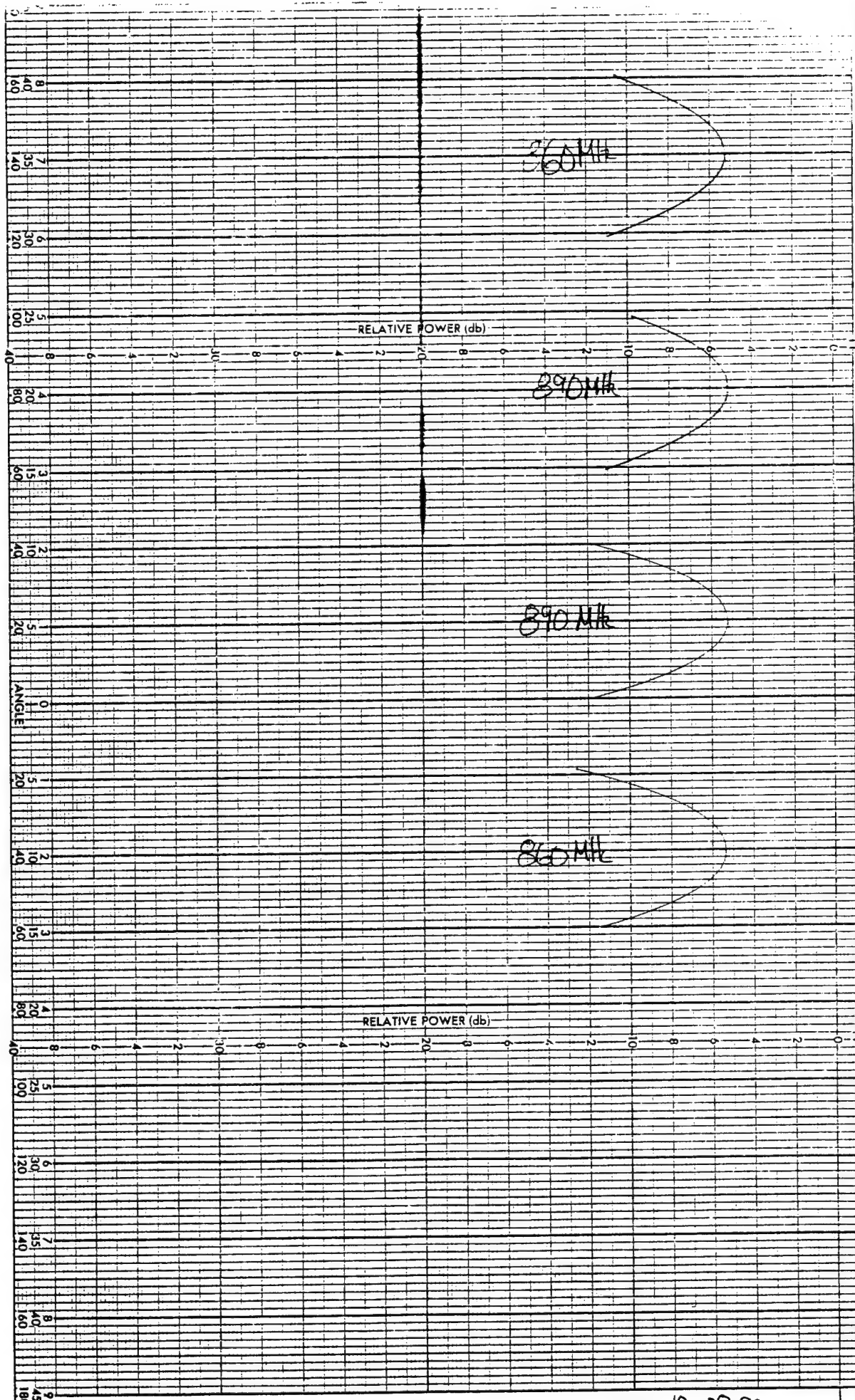
DATE

10-28-97

860 MHz

BI-Hen

A=10 215528



PROJECT
REMARKS

ENGR

DATE 10-28-92

nl=11

215520



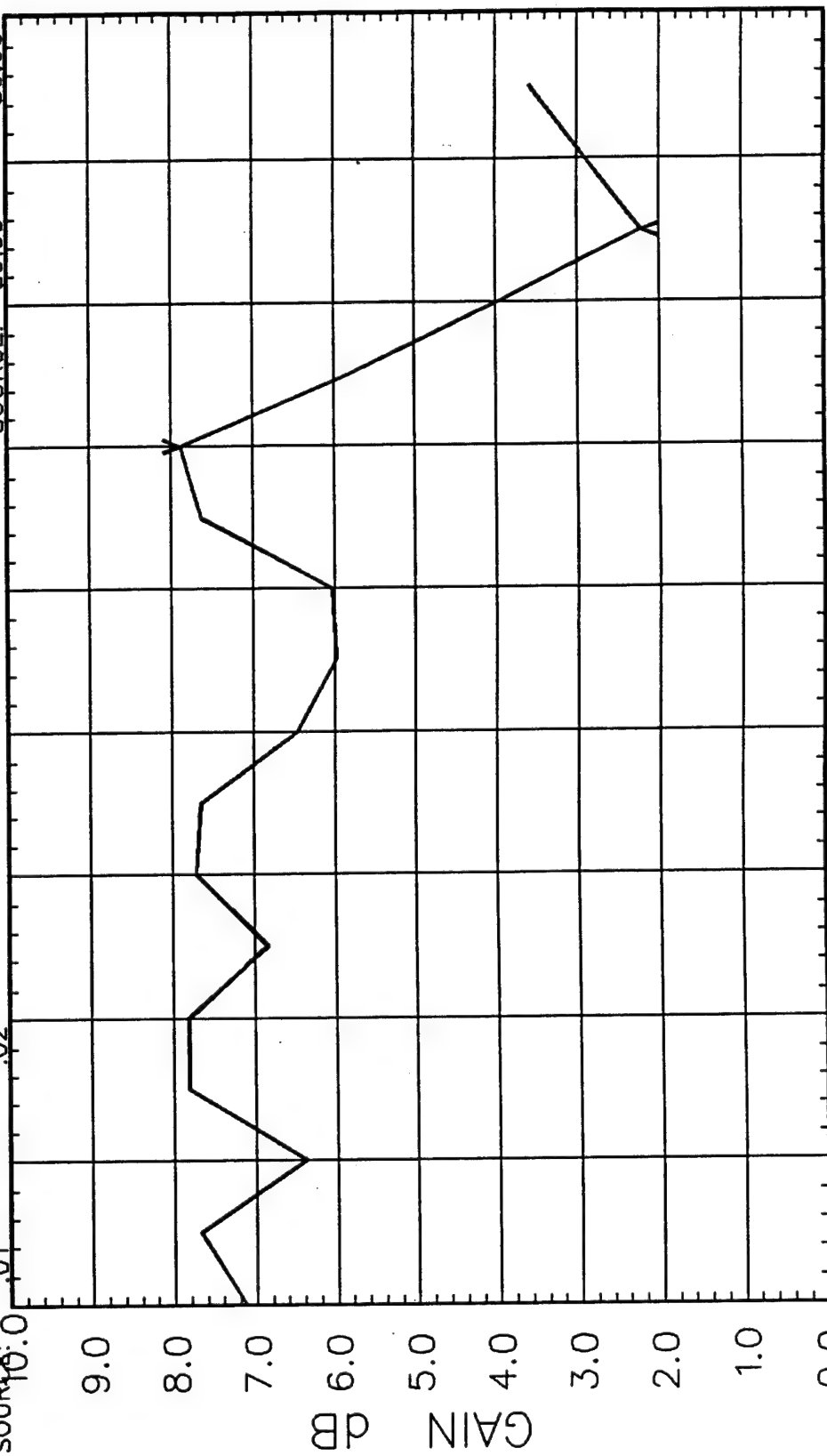
Appendix V

Antenna Below Variable Aperture

CAL FILE 1 DATA FILE 1 6" ABOVE 4FT GP
 NAME: TGNTSG1 6IN4FT1
 THETA: -.01
 PHI: .02
 SLIDE: -69.35 96.94
 SOURCE: .01 .02

TAGGANT

CAL FILE 2 DATA FILE 2
 NAME: TGNTSG3 6IN4FT2
 THETA: -.02
 PHI: 89.97
 SLIDE: -69.35 96.94
 SOURCE: 89.99 89.99



MAX 7.89 AT 370
 MIN 2.21 AT 400

FREQUENCY MHZ

OUTPUT FILE: TAGGANT

SGH IS AEL 250-500
 BALL AEROSPACE

```
*****  
*                                     *  
*               TAGGANT              *  
*   6" ABOVE 4FT GP      18 NOV 92  *  
*   CAL FILE #1 : TGNTSG1          *  
*       THETA ANGLE:    -.02        PHI ANGLE:         .00  
*       SLIDE ANGLE: -69.35        SOURCE ANGLE:        .01  
*                                     *  
*   CAL FILE #2 : TGNTSG3          *  
*       THETA ANGLE:    -.02        PHI ANGLE:        89.97  
*       SLIDE ANGLE: -69.35        SOURCE ANGLE:        89.99  
*                                     *  
*   DATA FILE #1 : 6IN4FT1        *  
*       THETA ANGLE:    -.01        PHI ANGLE:         .02  
*       SLIDE ANGLE:   96.94        SOURCE ANGLE:        .02  
*                                     *  
*   DATA FILE #2 : 6IN4FT2        *  
*       THETA ANGLE:    -.01        PHI ANGLE:         .02  
*       SLIDE ANGLE:   96.94        SOURCE ANGLE:        89.99  
*                                     *  
*   OUTPUT FILE:     TAGGANT        *  
*   GAIN STANDARD:   AEL 250-500   *  
*                                     *  
*****  
*                                     *  
*   FREQ      RHCP      LHCP      AXIAL      TILT      SGH      *  
*   MHZ      GAIN      GAIN      RATIO      ANGLE      GAIN      *  
*   250.      7.13      -2.13      6.24      -44.63      11.30      *  
*   260.      7.68      -5.38      3.93      63.90      11.57      *  
*   270.      6.37      -.61      8.36      -23.73      11.84      *  
*   280.      7.82      -10.06     2.23      33.30      12.11      *  
*   290.      7.81      -3.66      4.75      -64.12      12.38      *  
*   300.      6.84      -1.97      6.60      -20.17      12.65      *  
*   310.      7.71      -8.86      2.60       5.82      12.89      *  
*   320.      7.65      -6.62      3.40     -82.94      13.13      *  
*   330.      6.47      -2.38      6.57     -44.07      13.37      *  
*   340.      5.98      -4.33      5.48     -50.21      13.61      *  
*   350.      6.02     -15.78      1.42      12.99      13.85      *  
*   360.      7.63      -7.04      3.25     -88.17      14.02      *  
*   370.      7.89      -4.24      4.39     -72.42      14.19      *  
*   380.      5.84      -6.10      4.49     -44.93      14.36      *  
*   390.      3.99      -9.61      3.69     -37.53      14.53      *  
*   400.      2.21     -13.22      2.97     -13.53      14.70      *  
*   410.      2.90     -11.29      3.44     -70.56      14.91      *  
*   420.      3.58      -7.89      4.75     -78.45      15.12      *  
*                                     *  
*****
```

6" ABOVE 4FT GP
18 NOV 92

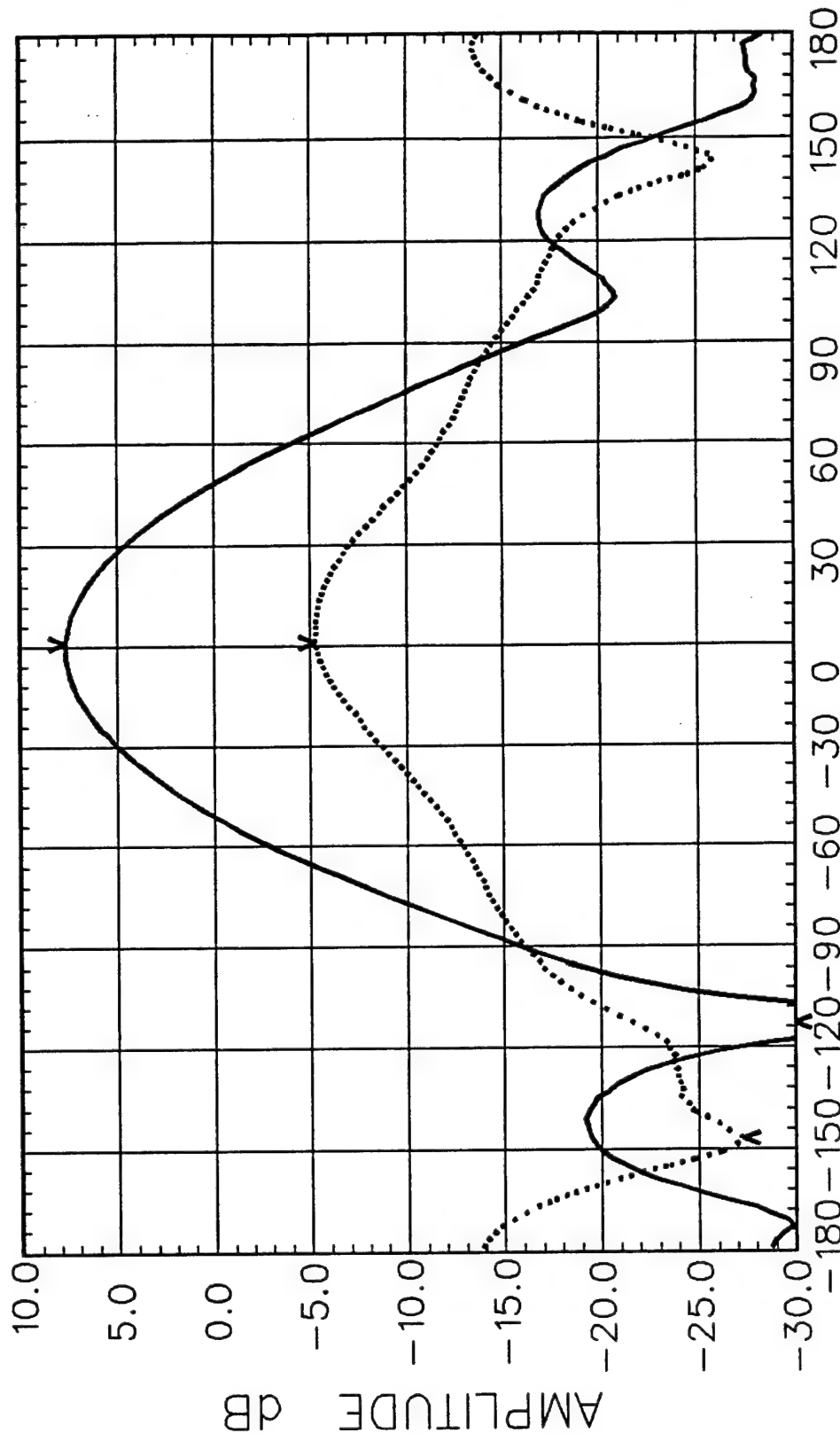
TAGGANT

BALL AEROSPACE

CP6561 HAS 15dB IF ATTEN
CP6561 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

260MHz RHCP GAIN PHI=
260MHz LHCP GAIN PHI=



THETA ANGLE

MAX: 7.70dB at 1deg MIN: -38.64dB at -113deg
MAX: -5.23dB at 1deg MIN: -27.33dB at -147deg

6" ABOVE 4FT GP
18 NOV 92

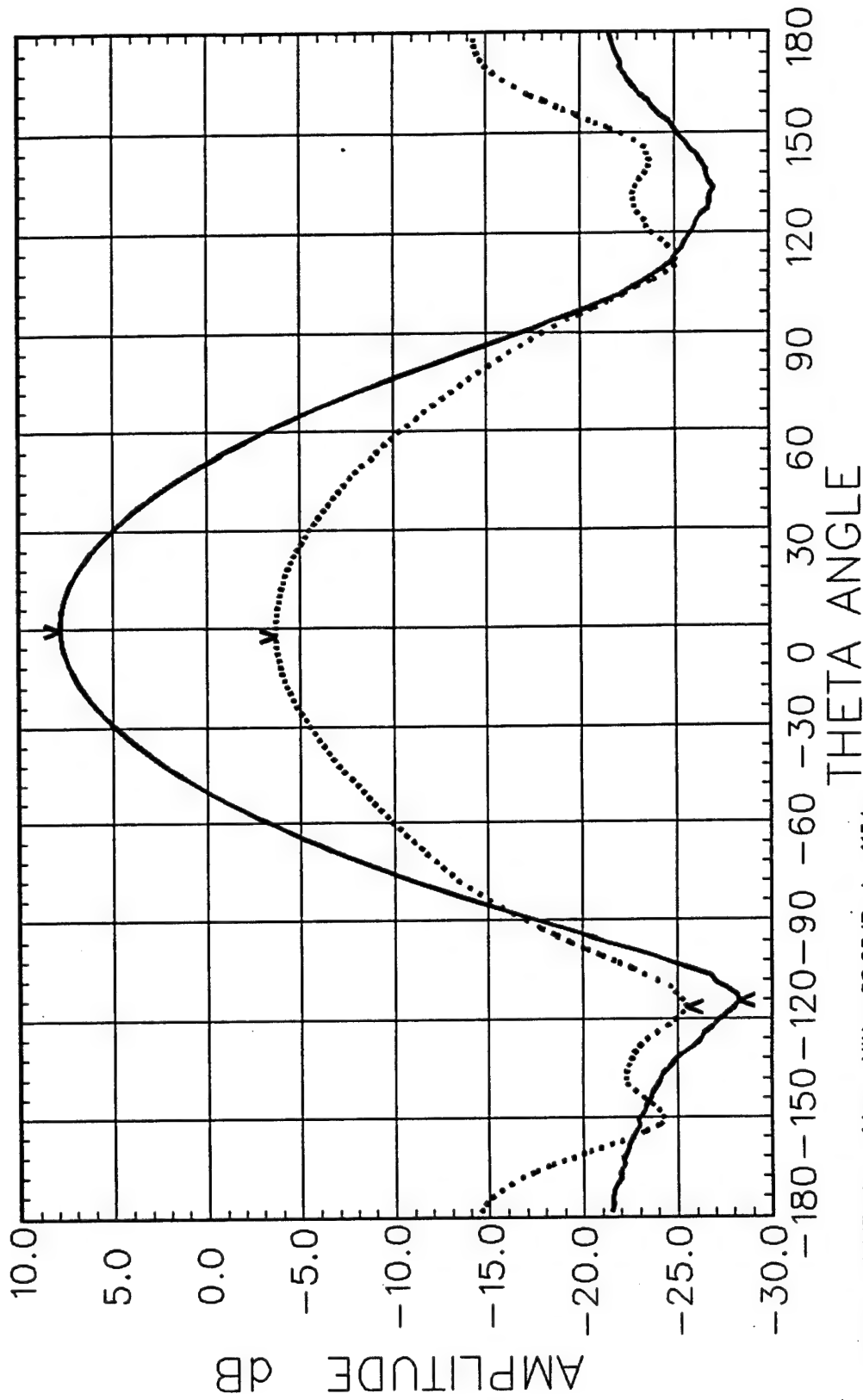
TAGGANT

BALL AEROSPACE

CP6562 HAS 15dB IF ATTEN
CP6562 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

290MHz RHCP GAIN PHI=
290MHz LHCP GAIN PHI=



MAX: 7.81dB at -1deg MIN: -28.28dB at -115deg
MAX: -3.68dB at -3deg MIN: -25.53dB at -117deg

6" ABOVE 4FT GP
18 NOV 92

TAGGANT

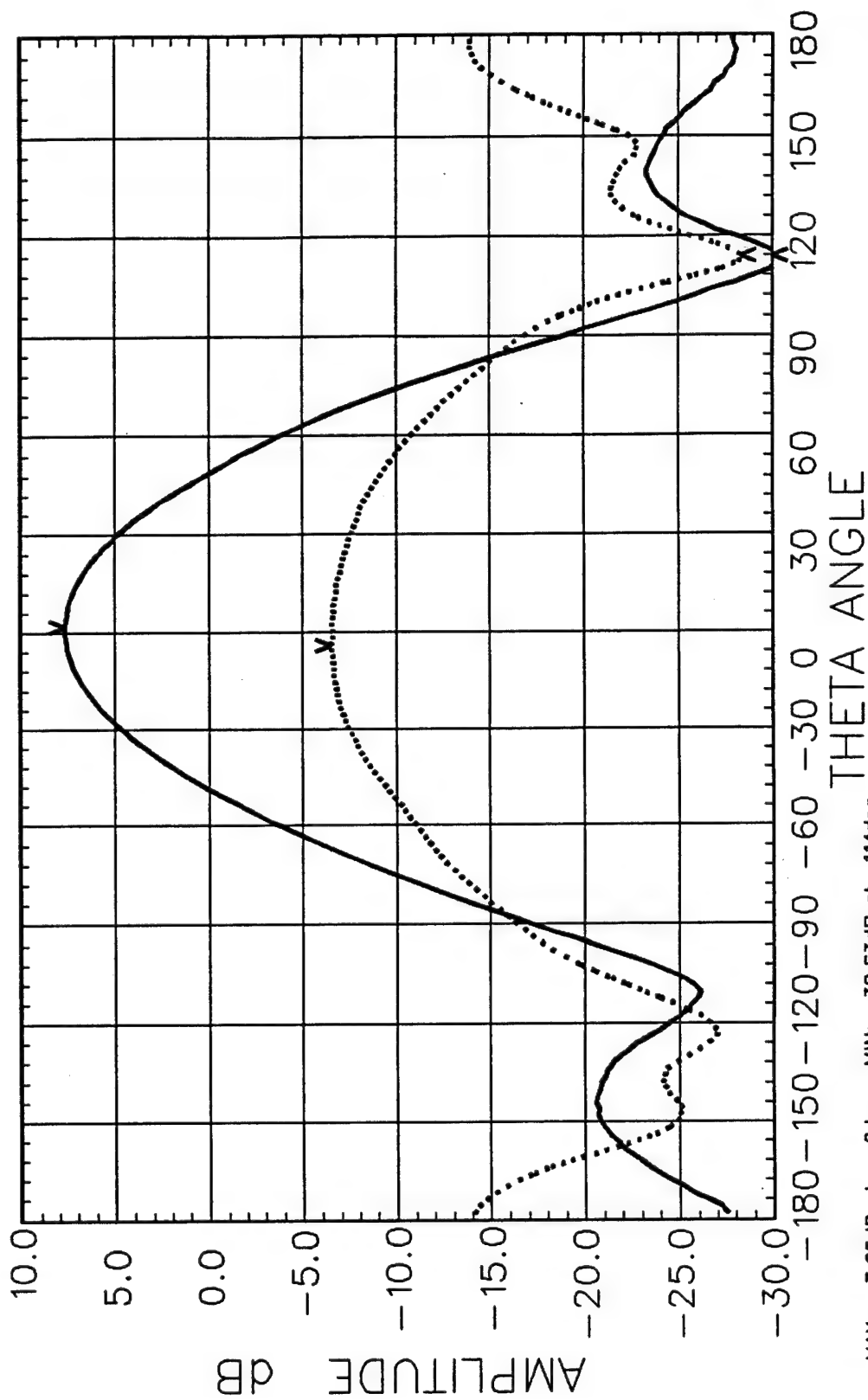
BALL AEROSPACE

CP6563 HAS 15dB IF ATTEN
CP6563 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

320MHz RHCP GAIN PHI=
320MHz LHCP GAIN PHI=

is
is



MAX: 7.66dB at 2deg MIN: -30.63dB at 114deg
MAX: -6.52dB at -4deg MIN: -28.34dB at 114deg

1) RPL:19 MAY 92
2) RPL:19 MAY 92
CP6563:28 OCT 91
CP6563:28 OCT 91

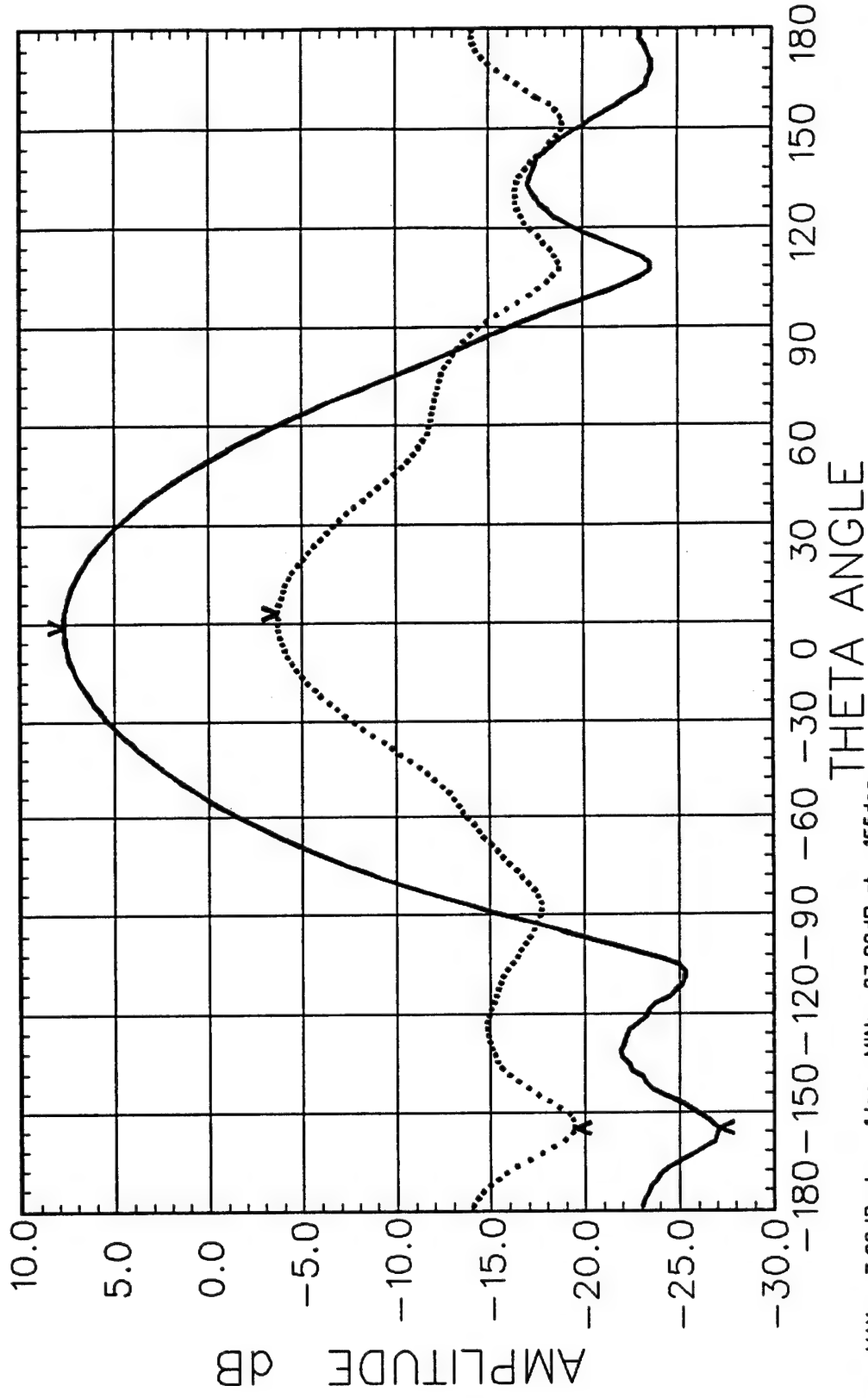
6" ABOVE 4FT GP
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6581 HAS 15dB IF ATTEN
CP6581 HAS 15dB IF ATTEN

— is 260MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 260MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



— MAX: 7.69dB at -1deg MIN: -27.09dB at -155deg
..... MAX: -3.69dB at 3deg MIN: -19.50dB at -155deg

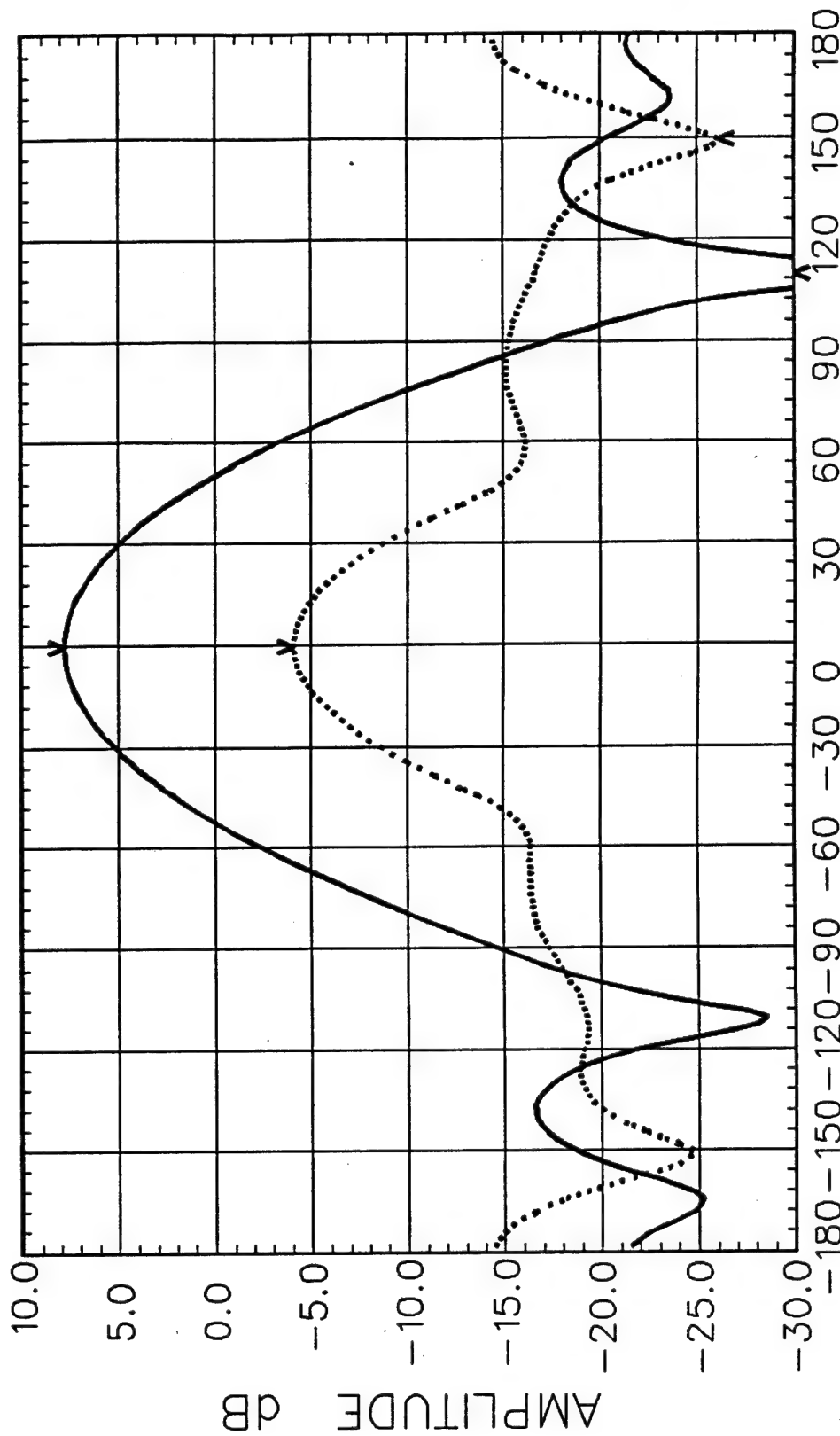
6" ABOVE 4FT GP
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6582 HAS 15dB IF ATTEN
CP6582 HAS 15dB IF ATTEN

250MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
250MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



THETA ANGLE

MAX: 7.77dB at -1deg MIN: -49.92dB at 109deg
MAX: -4.09dB at -1deg MIN: -26.13dB at 149deg

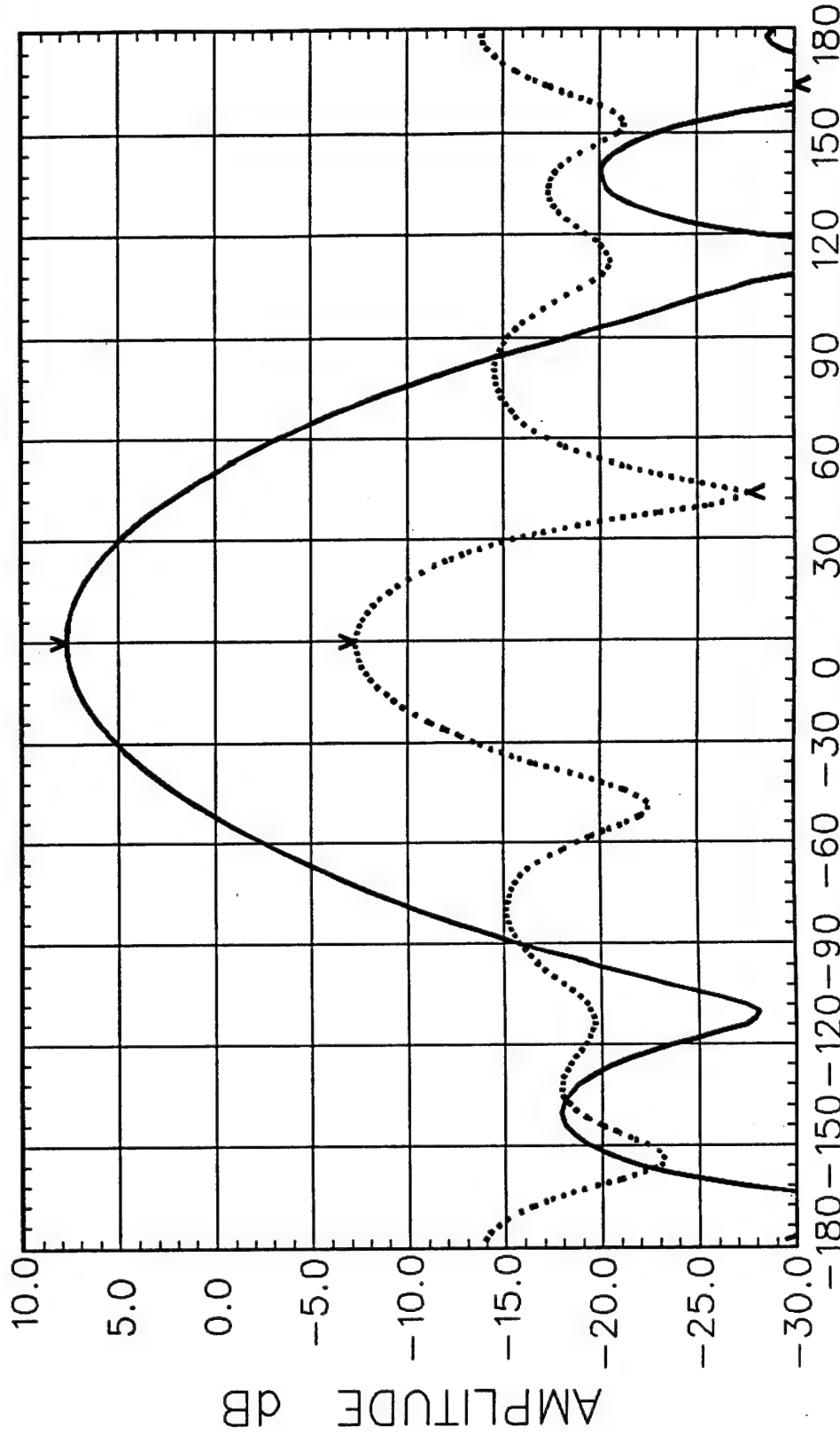
6" ABOVE 4FT GP
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6583 HAS 15dB IF ATTEN
CP6583 HAS 15dB IF ATTEN

320MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
320MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



THETA ANGLE

— MAX: 7.69dB at 0deg MIN: -59.95dB at 164deg
..... MAX: -7.27dB at 0deg MIN: -27.65dB at 44deg

1) PERFORM MAY 92
2) PERFORM MAY 92
3) PERFORM MAY 92
4) PERFORM MAY 92
5) PERFORM MAY 92
6) PERFORM MAY 92
7) PERFORM MAY 92
8) PERFORM MAY 92
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97) PERFORM MAY 92
98) PERFORM MAY 92
99) PERFORM MAY 92
100) PERFORM MAY 92

CAL FILE 1 DATA FILE 1 1/8 BELOW GP, 1" BORDER
TGNTSG1 1D81IN1 18 NOV 92

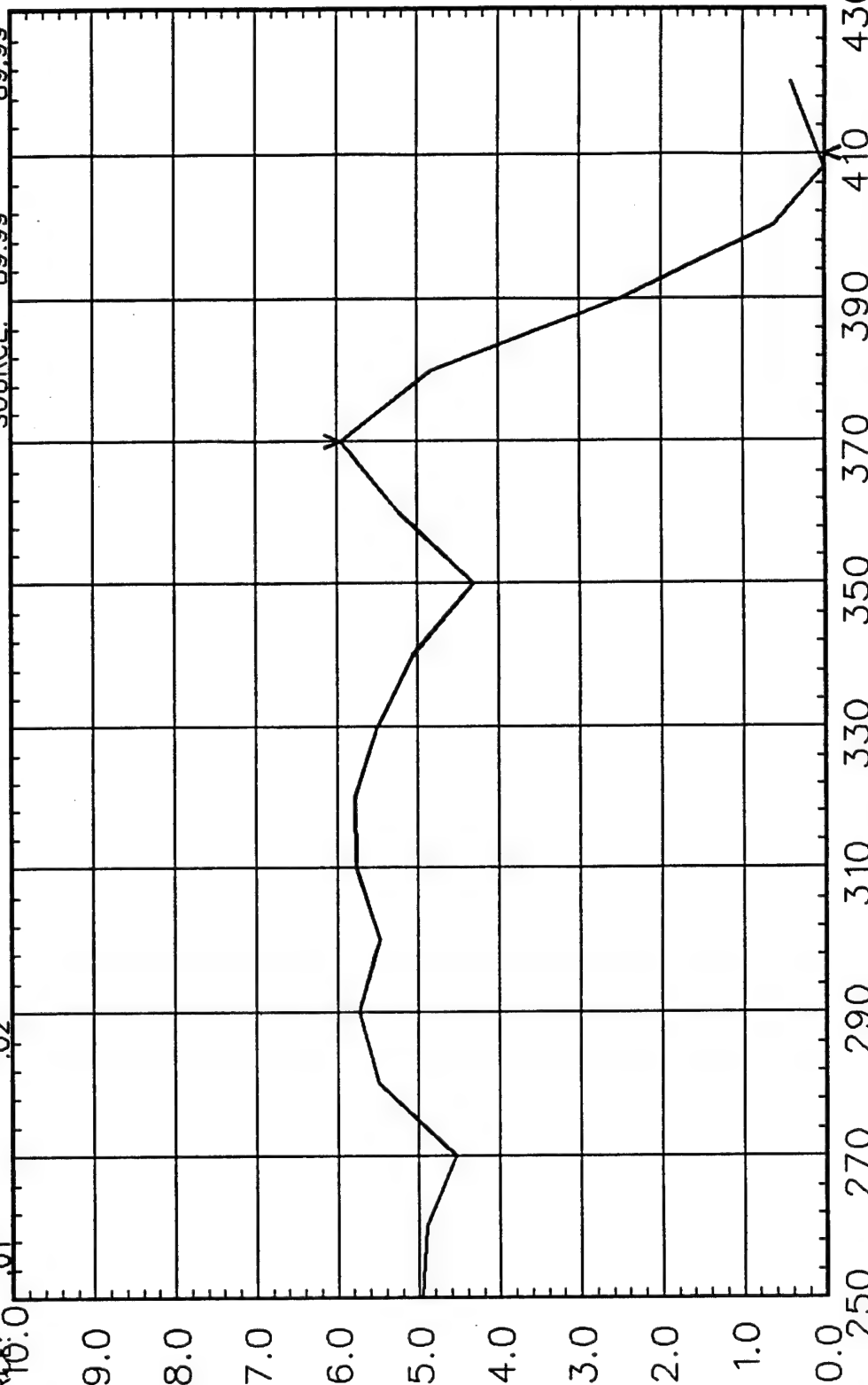
NAME:
THETA:
PHI:
SLIDE:
SOURCE:

-02
.00
-69.35
96.74
.02

TAGGANT

CAL FILE 2 DATA FILE 2
TGNTSG3 1D81IN2
NAME:
THETA:
PHI:
SLIDE:
SOURCE:

-02
89.97
-69.35
89.99
89.99



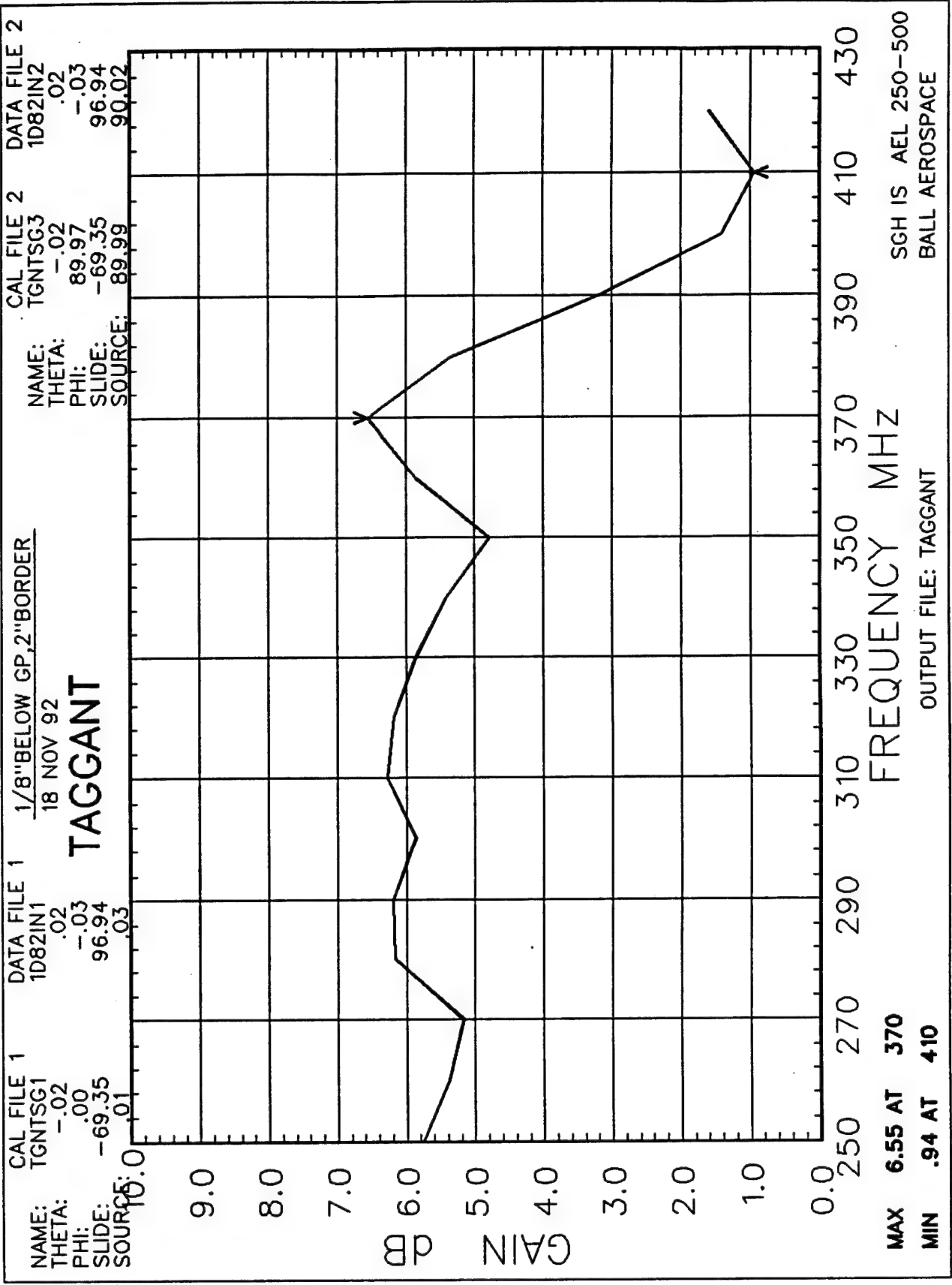
MAX 5.95 AT 370
MIN -.14 AT 410

FREQUENCY MHz

OUTPUT FILE: TAGGANT

SGH IS AEL 250-500
BALL AEROSPACE

```
*****  
*                                     *  
*               TAGGANT              *  
*    1/8 BELOW GP,1"BORDER      18 NOV 92   *  
*    CAL FILE #1 : TGNTSG1        *  
*            THETA ANGLE:   -.02          PHI ANGLE:       .00  
*            SLIDE ANGLE: -69.35         SOURCE ANGLE:     .01  
*  
*    CAL FILE #2 : TGNTSG3        *  
*            THETA ANGLE:   -.02          PHI ANGLE:      89.97  
*            SLIDE ANGLE: -69.35         SOURCE ANGLE:     89.99  
*  
*    DATA FILE #1 :1D81IN1       *  
*            THETA ANGLE:   -.01          PHI ANGLE:       .00  
*            SLIDE ANGLE:  96.74         SOURCE ANGLE:     .02  
*  
*    DATA FILE #2 :1D81IN2       *  
*            THETA ANGLE:   -.01          PHI ANGLE:       .00  
*            SLIDE ANGLE:  96.72         SOURCE ANGLE:     89.99  
*  
*    OUTPUT FILE:   TAGGANT        *  
*    GAIN STANDARD: AEL 250-500    *  
*****  
*                                     *  
*    FREQ           RHCP           LHCP           AXIAL           TILT           SGH  
*    MHZ            GAIN            GAIN            RATIO            ANGLE            GAIN  
*    250.           4.96           -2.07           8.32           -75.57          11.30  
*    260.           4.91           -.85            9.91           42.05          11.57  
*    270.           4.54           -3.34           7.44           -47.00          11.84  
*    280.           5.49           -4.81           5.48           19.87          12.11  
*    290.           5.73           -5.08           5.15           86.40          12.38  
*    300.           5.47           -6.66           4.39           -34.53          12.65  
*    310.           5.76           -6.59           4.27           10.94          12.89  
*    320.           5.78           -6.49           4.32           68.59          13.13  
*    330.           5.50           -8.15           3.67           -72.20          13.37  
*    340.           5.06           -12.01          2.45           -77.27          13.61  
*    350.           4.31           -9.00           3.82           28.21          13.85  
*    360.           5.23           -8.12           3.80           50.47          14.02  
*    370.           5.95           -10.50          2.63           59.40          14.19  
*    380.           4.84           -30.90          .28            4.61          14.36  
*    390.           2.51           -18.57          1.54           -2.81          14.53  
*    400.           .62           -14.54          3.06           10.87          14.70  
*    410.           -.14          -17.70          2.31           35.47          14.91  
*    420.           .41           -15.29          2.88           37.92          15.12  
*  
*****
```



```

*****
*
*               TAGGANT
* 1/8"BELOW GP,2"BORDER      18 NOV 92
* CAL FILE #1 : TGNTSG1
*   THETA ANGLE:  -.02      PHI ANGLE:      .00
*   SLIDE ANGLE: -69.35     SOURCE ANGLE:    .01
*
* CAL FILE #2 : TGNTSG3
*   THETA ANGLE:  -.02      PHI ANGLE:      89.97
*   SLIDE ANGLE: -69.35     SOURCE ANGLE:    89.99
*
* DATA FILE #1 :1D82IN1
*   THETA ANGLE:   .02      PHI ANGLE:      -.03
*   SLIDE ANGLE:  96.94     SOURCE ANGLE:    .03
*
* DATA FILE #2 :1D82IN2
*   THETA ANGLE:   .02      PHI ANGLE:      -.03
*   SLIDE ANGLE:  96.94     SOURCE ANGLE:    90.02
*
* OUTPUT FILE:   TAGGANT
* GAIN STANDARD: AEL 250-500
*
*****

```

```

*****
*
*   FREQ      RHCP      LHCP      AXIAL      TILT      SGH
*   MHz       GAIN      GAIN      RATIO     ANGLE     GAIN
*
*   250.      5.75      -3.99      5.88      88.21     11.30
*   260.      5.38      -.95       9.14      35.68     11.57
*   270.      5.17      -3.80      6.47      -42.60    11.84
*   280.      6.17      -6.55      4.09      21.00     12.11
*   290.      6.19      -6.32      4.19      81.02     12.38
*   300.      5.86      -6.67      4.18      -29.00    12.65
*   310.      6.27      -8.05      3.38      11.27     12.89
*   320.      6.18      -7.08      3.84      66.93     13.13
*   330.      5.86      -9.08      3.14      -66.80    13.37
*   340.      5.41     -12.51     2.22      -77.99    13.61
*   350.      4.78      -9.13      3.55      28.70     13.85
*   360.      5.86      -9.58      2.96      53.53     14.02
*   370.      6.55     -11.83     2.10      60.68     14.19
*   380.      5.35     -20.28     .91       -16.65    14.36
*   390.      3.20     -17.89     1.54      -5.37     14.53
*   400.      1.40     -13.49     3.16      9.35      14.70
*   410.      .94      -20.56     1.47      36.39     14.91
*   420.      1.59     -17.39     1.96      40.98     15.12
*
*****

```


1/8"BELOW GP,3"BORDER

CAL FILE 1

DATA FILE 1

1D83IN1

NAME: TGNTSG1

THETA: -.02

PHI: .03

SLIDE: -69.35

SOURCE: .03

18 NOV 92

TAGGANT

CAL FILE 2

DATA FILE 2

1D83IN2

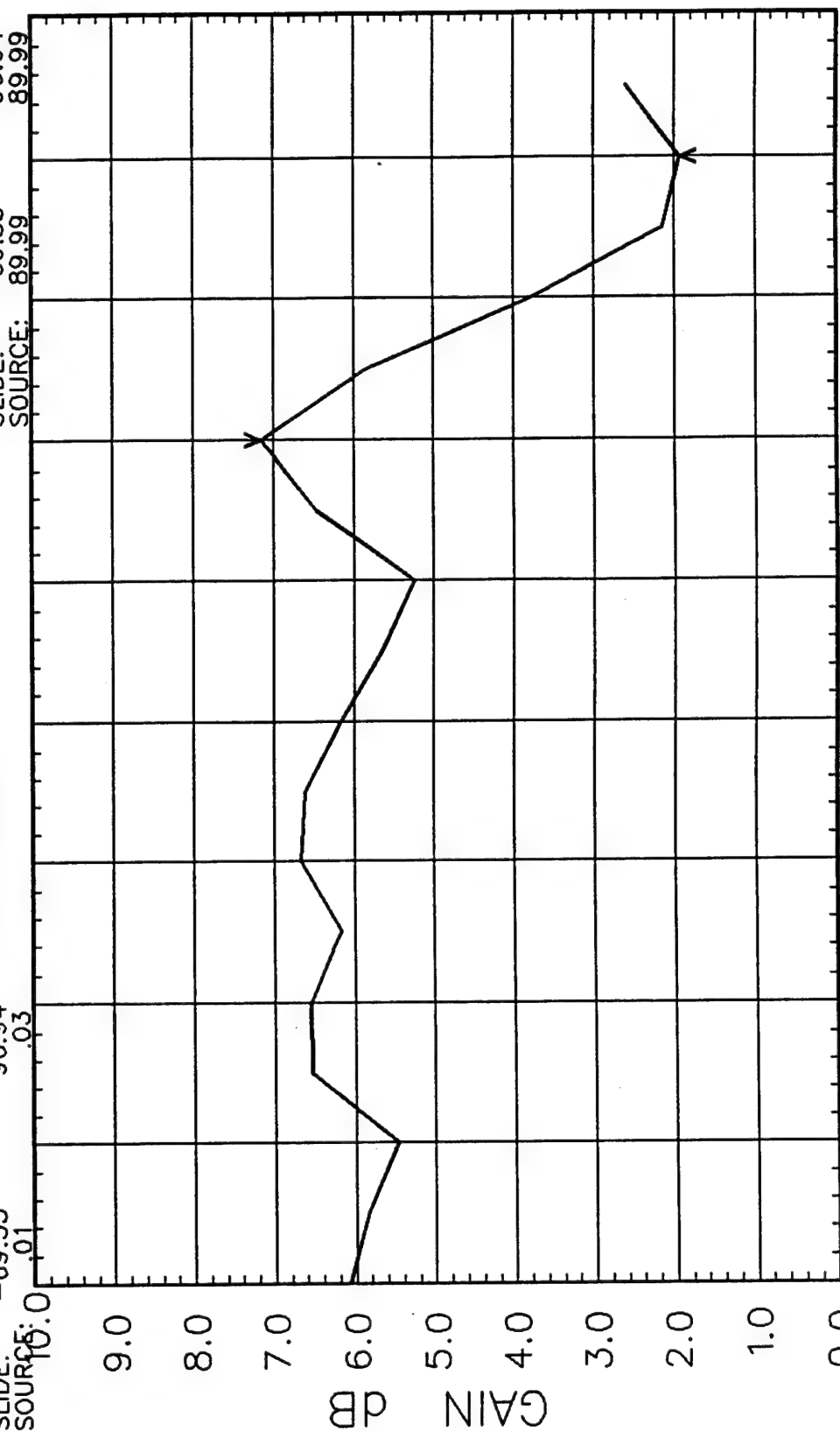
NAME: TGNTSG3

THETA: -.02

PHI: 89.97

SLIDE: -69.35

SOURCE: 89.99



MAX 7.15 AT 370

MIN 1.93 AT 410

FREQUENCY MHZ

OUTPUT FILE: TAGGANT

SGH IS AEL 250-500
BALL AEROSPACE

```

*****
*
*                               TAGGANT
* 1/8"BELOW GP,3"BORDER      18 NOV 92
* CAL FILE #1 : TGNTSG1
*   THETA ANGLE:   -.02      PHI ANGLE:   .00
*   SLIDE ANGLE: -69.35     SOURCE ANGLE: .01
*
* CAL FILE #2 : TGNTSG3
*   THETA ANGLE:   -.02      PHI ANGLE:   89.97
*   SLIDE ANGLE: -69.35     SOURCE ANGLE: 89.99
*
* DATA FILE #1 :1D83IN1
*   THETA ANGLE:   -.02      PHI ANGLE:   .03
*   SLIDE ANGLE:  96.94     SOURCE ANGLE: .03
*
* DATA FILE #2 :1D83IN2
*   THETA ANGLE:   -.02      PHI ANGLE:   .03
*   SLIDE ANGLE:  96.94     SOURCE ANGLE: 89.99
*
* OUTPUT FILE:   TAGGANT
* GAIN STANDARD: AEL 250-500
*
*****

```

```

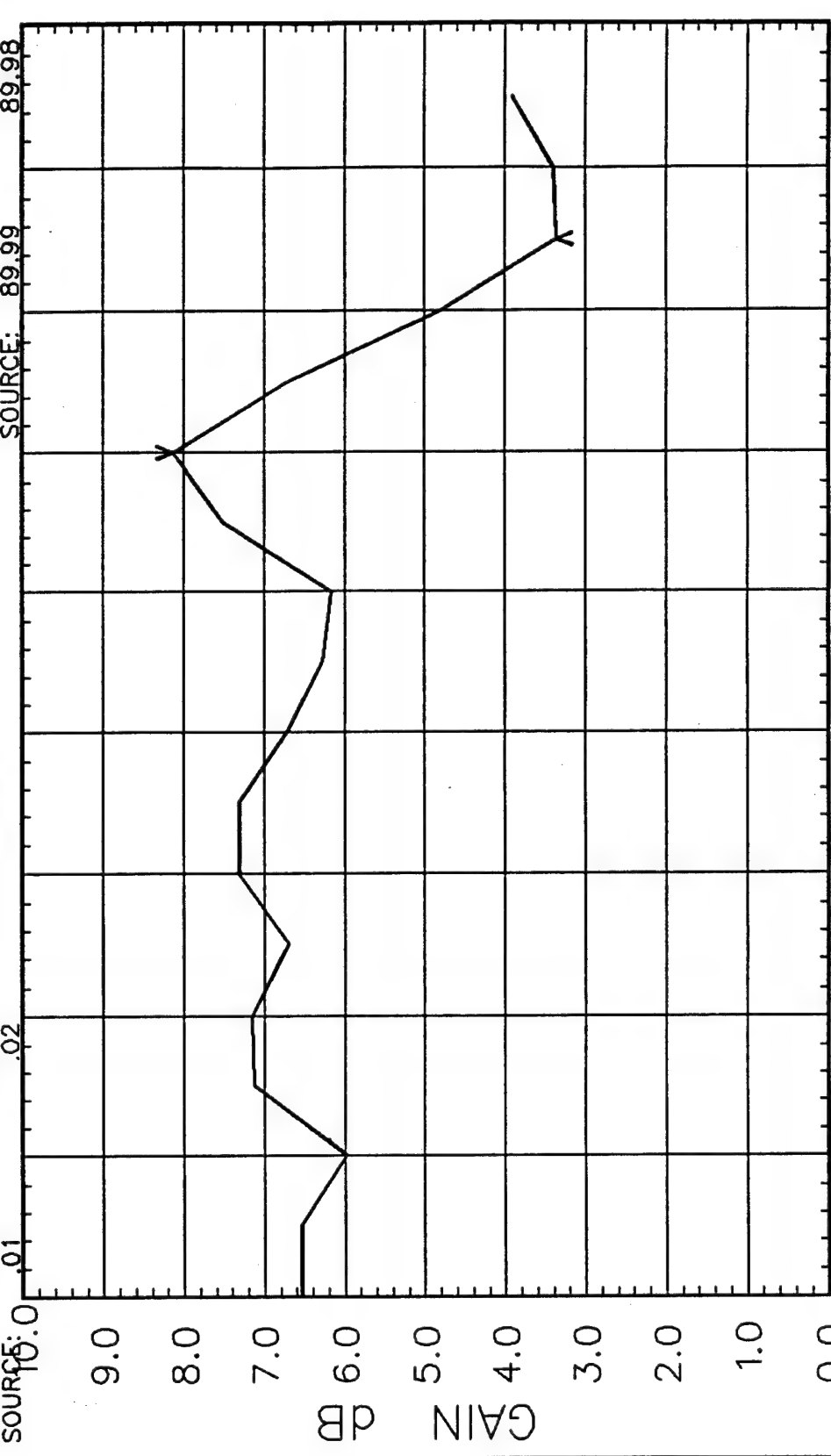
*****
*
*  FREQ      RHCP      LHCP      AXIAL      TILT      SGH
*  MHz      GAIN      GAIN      RATIO      ANGLE      GAIN
*
*  250.      6.08      -6.40      4.21      -89.21      11.30
*  260.      5.84      -1.83      7.64      34.82      11.57
*  270.      5.47      -3.83      6.21      -38.37      11.84
*  280.      6.54      -8.14      3.24      20.20      12.11
*  290.      6.55      -7.47      3.51      85.52      12.38
*  300.      6.17      -6.23      4.25      -25.51      12.65
*  310.      6.67      -8.76      2.97      11.41      12.89
*  320.      6.61      -8.25      3.18      70.02      13.13
*  330.      6.17      -8.91      3.09      -59.36      13.37
*  340.      5.64      -12.94     2.05      -69.77      13.61
*  350.      5.24      -9.74      3.13      29.74      13.85
*  360.      6.47      -11.14     2.30      60.28      14.02
*  370.      7.15      -14.13     1.50      69.53      14.19
*  380.      5.85      -15.44     1.50      -22.92      14.36
*  390.      3.78      -16.15     1.76      -10.83      14.53
*  400.      2.14      -13.19     3.00      7.92       14.70
*  410.      1.93      -26.18     .68       46.26      14.91
*  420.      2.60      -19.99     1.29      52.46      15.12
*
*****

```

CAL FILE 1 DATA FILE 1 1/8"BELOW GP,5"BORDER
TGNTSG1 1D85IN1 18 NOV 92

CAL FILE 2 DATA FILE 2
TGNTSG3 1D85IN2
NAME: THETA: .02
PHI: 89.97
SLIDE: -69.35
SOURCE: 89.99

TAGGANT



MAX 8.13 AT 370
MIN 3.36 AT 400

FREQUENCY MHZ

OUTPUT FILE: TAGGANT

SGH IS AEL 250-500
BALL AEROSPACE

```

*****
*
*                               TAGGANT
* 1/8"BELOW GP,5"BORDER      18 NOV 92
* CAL FILE #1 : TGNTSG1
*   THETA ANGLE:  -.02      PHI ANGLE:      .00
*   SLIDE ANGLE: -69.35     SOURCE ANGLE:    .01
*
* CAL FILE #2 : TGNTSG3
*   THETA ANGLE:  -.02      PHI ANGLE:      89.97
*   SLIDE ANGLE: -69.35     SOURCE ANGLE:    89.99
*
* DATA FILE #1 :1D85IN1
*   THETA ANGLE:   .02      PHI ANGLE:      -.04
*   SLIDE ANGLE:  96.94     SOURCE ANGLE:    .02
*
* DATA FILE #2 :1D85IN2
*   THETA ANGLE:   .02      PHI ANGLE:      -.04
*   SLIDE ANGLE:  96.94     SOURCE ANGLE:    89.98
*
* OUTPUT FILE:  TAGGANT
* GAIN STANDARD: AEL 250-500
*
*****

```

```

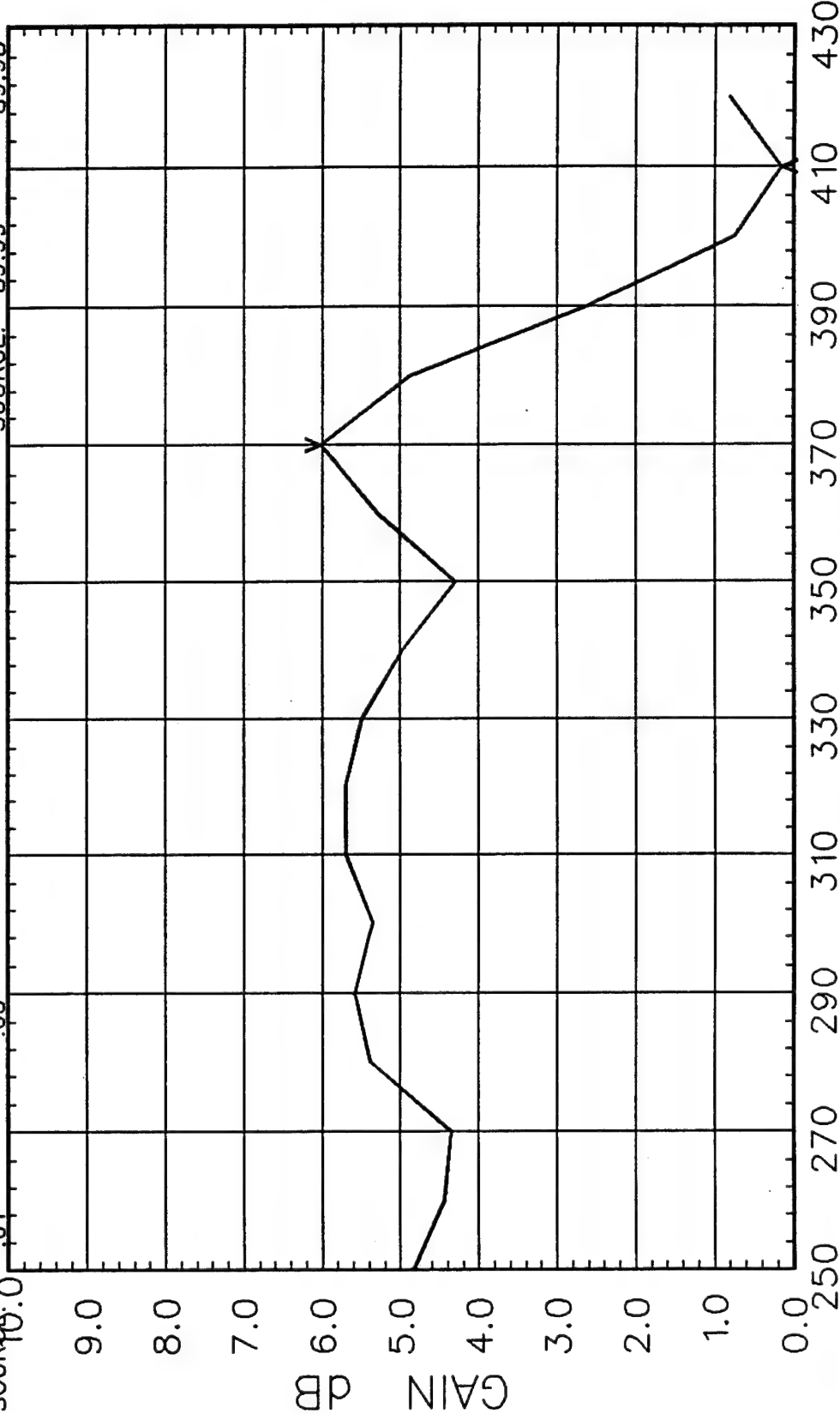
*****
*
*   FREQ      RHCP      LHCP      AXIAL      TILT      SGH
*   MHZ      GAIN      GAIN      RATIO      ANGLE      GAIN
* 250.      6.54      -8.59      3.07      -78.71      11.30
* 260.      6.54      -3.82      5.44      34.39      11.57
* 270.      5.98      -3.27      6.25      -35.76      11.84
* 280.      7.13      -12.31     1.86      18.20      12.11
* 290.      7.15      -8.14      3.02      -84.60      12.38
* 300.      6.70      -5.09      4.58      -24.34      12.65
* 310.      7.32      -11.01     2.12      7.61      12.89
* 320.      7.31      -9.00      2.68      80.37      13.13
* 330.      6.72      -6.80      3.72      -52.91      13.37
* 340.      6.27      -10.14     2.65      -62.27      13.61
* 350.      6.17      -11.68     2.24      32.06      13.85
* 360.      7.51      -11.19     2.03      78.16      14.02
* 370.      8.13      -12.87     1.55      -86.65      14.19
* 380.      6.73      -10.70     2.35      -31.45      14.36
* 390.      4.81      -13.78     2.05      -21.67      14.53
* 400.      3.36      -13.25     2.59      3.15      14.70
* 410.      3.39      -21.41     1.00      -76.49      14.91
* 420.      3.91      -17.91     1.41      88.47      15.12
*
*****

```

CAL FILE 1 DATA FILE 1 1/2"BELOW GP,1"BORDER
NAME: TGNTSG1 1D21IN1
THETA: -.03
PHI: -.04
SLIDE: -69.35 96.98
SOURCE: .01

CAL FILE 2 DATA FILE 2
NAME: TGNTSG3 1D21IN2
THETA: -.02
PHI: 89.97
SLIDE: -69.35 96.94
SOURCE: 89.99 89.98

TAGGANT



MAX 6.01 AT 370
MIN .15 AT 410

FREQUENCY MHZ

OUTPUT FILE: TAGGANT

SGH IS AEL 250-500
BALL AEROSPACE

```

*****
*
*                               TAGGANT
*
* 1/2"BELOW GP,1"BORDER      18 NOV 92
* CAL FILE #1 : TGNTSG1
*      THETA ANGLE:  -.02      PHI ANGLE:      .00
*      SLIDE ANGLE: -69.35     SOURCE ANGLE:   .01
*
* CAL FILE #2 : TGNTSG3
*      THETA ANGLE:  -.02      PHI ANGLE:      89.97
*      SLIDE ANGLE: -69.35     SOURCE ANGLE:   89.99
*
* DATA FILE #1 :1D21IN1
*      THETA ANGLE:   .03      PHI ANGLE:      -.04
*      SLIDE ANGLE:  96.98     SOURCE ANGLE:   .03
*
* DATA FILE #2 :1D21IN2
*      THETA ANGLE:   .03      PHI ANGLE:      -.04
*      SLIDE ANGLE:  96.94     SOURCE ANGLE:   89.98
*
* OUTPUT FILE:  TAGGANT
* GAIN STANDARD: AEL 250-500
*
*****

```

```

*****

```

FREQ MHZ	RHCP GAIN	LHCP GAIN	AXIAL RATIO	TILT ANGLE	SGH GAIN
250.	4.83	-1.70	8.89	-83.11	11.30
260.	4.44	-.39	11.34	41.64	11.57
270.	4.35	-3.45	7.51	-45.71	11.84
280.	5.39	-4.56	5.72	24.91	12.11
290.	5.59	-4.60	5.56	84.60	12.38
300.	5.35	-6.83	4.37	-32.77	12.65
310.	5.70	-6.46	4.38	15.57	12.89
320.	5.70	-5.93	4.66	68.76	13.13
330.	5.49	-8.23	3.63	-71.38	13.37
340.	4.97	-12.66	2.29	-79.03	13.61
350.	4.29	-8.20	4.21	30.85	13.85
360.	5.29	-7.78	3.92	52.94	14.02
370.	6.01	-10.20	2.71	59.84	14.19
380.	4.89	-26.26	.48	1.81	14.36
390.	2.63	-17.71	1.68	3.88	14.53
400.	.75	-13.56	3.39	13.80	14.70
410.	.15	-17.70	2.24	37.33	14.91
420.	.81	-15.44	2.70	37.92	15.12

```

*****

```


1/2"BELOW GP,2"BORDER

CAL FILE 1

DATA FILE 1

DATA FILE 2

NAME: TGNTSG1
THETA: -.02
PHI: .00
SLIDE: -69.35
SOURCE: .01

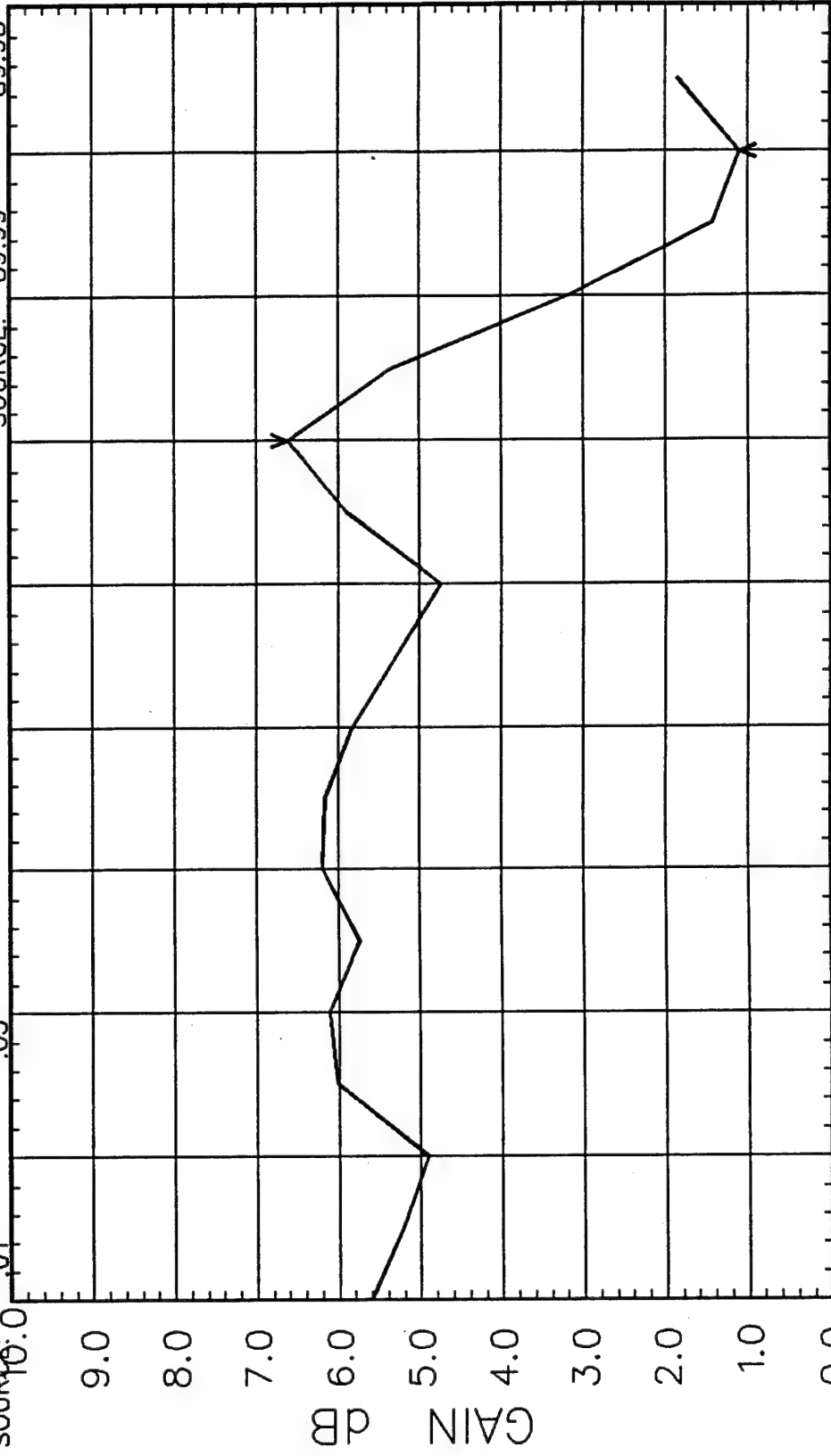
1D22IN1
.02
.01
96.92
.03

18 NOV 92

TAGGANT

NAME: TGNTSG3
THETA: -.02
PHI: 89.97
SLIDE: -69.35
SOURCE: 89.99

1D22IN2
.02
.01
96.94
89.98



MAX 6.61 AT 370
MIN 1.09 AT 410

FREQUENCY MHZ

OUTPUT FILE: TAGGANT

SGH IS AEL 250-500
BALL AEROSPACE

```

*****
*
*               TAGGANT
* 1/2"BELOW GP,2"BORDER      18 NOV 92
* CAL FILE #1 : TGNTSG1
*   THETA ANGLE:  -.02      PHI ANGLE:      .00
*   SLIDE ANGLE: -69.35     SOURCE ANGLE:    .01
*
* CAL FILE #2 : TGNTSG3
*   THETA ANGLE:  -.02      PHI ANGLE:      89.97
*   SLIDE ANGLE: -69.35     SOURCE ANGLE:    89.99
*
* DATA FILE #1 :1D22IN1
*   THETA ANGLE:   .02      PHI ANGLE:      .01
*   SLIDE ANGLE:  96.92     SOURCE ANGLE:    .03
*
* DATA FILE #2 :1D22IN2
*   THETA ANGLE:   .02      PHI ANGLE:      .01
*   SLIDE ANGLE:  96.94     SOURCE ANGLE:    89.98
*
* OUTPUT FILE:  TAGGANT
* GAIN STANDARD: AEL 250-500
*
*****

```

```

*****
*
*   FREQ      RHCP      LHCP      AXIAL      TILT      SGH
*   MHZ       GAIN      GAIN      RATIO     ANGLE     GAIN
*
*   250.      5.60      -3.49      6.37      -84.94    11.30
*   260.      5.21      -.96       9.34      39.51     11.57
*   270.      4.90      -3.64      6.83      -40.68    11.84
*   280.      6.02      -6.04      4.43      24.38     12.11
*   290.      6.11      -5.89      4.46      85.40     12.38
*   300.      5.74      -6.61      4.28      -27.55    12.65
*   310.      6.19      -7.46      3.66      15.49     12.89
*   320.      6.16      -6.95      3.91      70.22     13.13
*   330.      5.83      -9.02      3.18      -64.07    13.37
*   340.      5.29      -13.49     2.01      -74.13    13.61
*   350.      4.74      -8.76      3.73      31.72     13.85
*   360.      5.89      -9.50      2.98      57.16     14.02
*   370.      6.61      -12.21     2.00      63.87     14.19
*   380.      5.36      -19.19     1.03      -14.51    14.36
*   390.      3.19      -16.68     1.77      -.49      14.53
*   400.      1.43      -13.13     3.29      12.78     14.70
*   410.      1.09      -21.23     1.33      39.55     14.91
*   420.      1.85      -17.91     1.79      42.57     15.12
*
*****

```

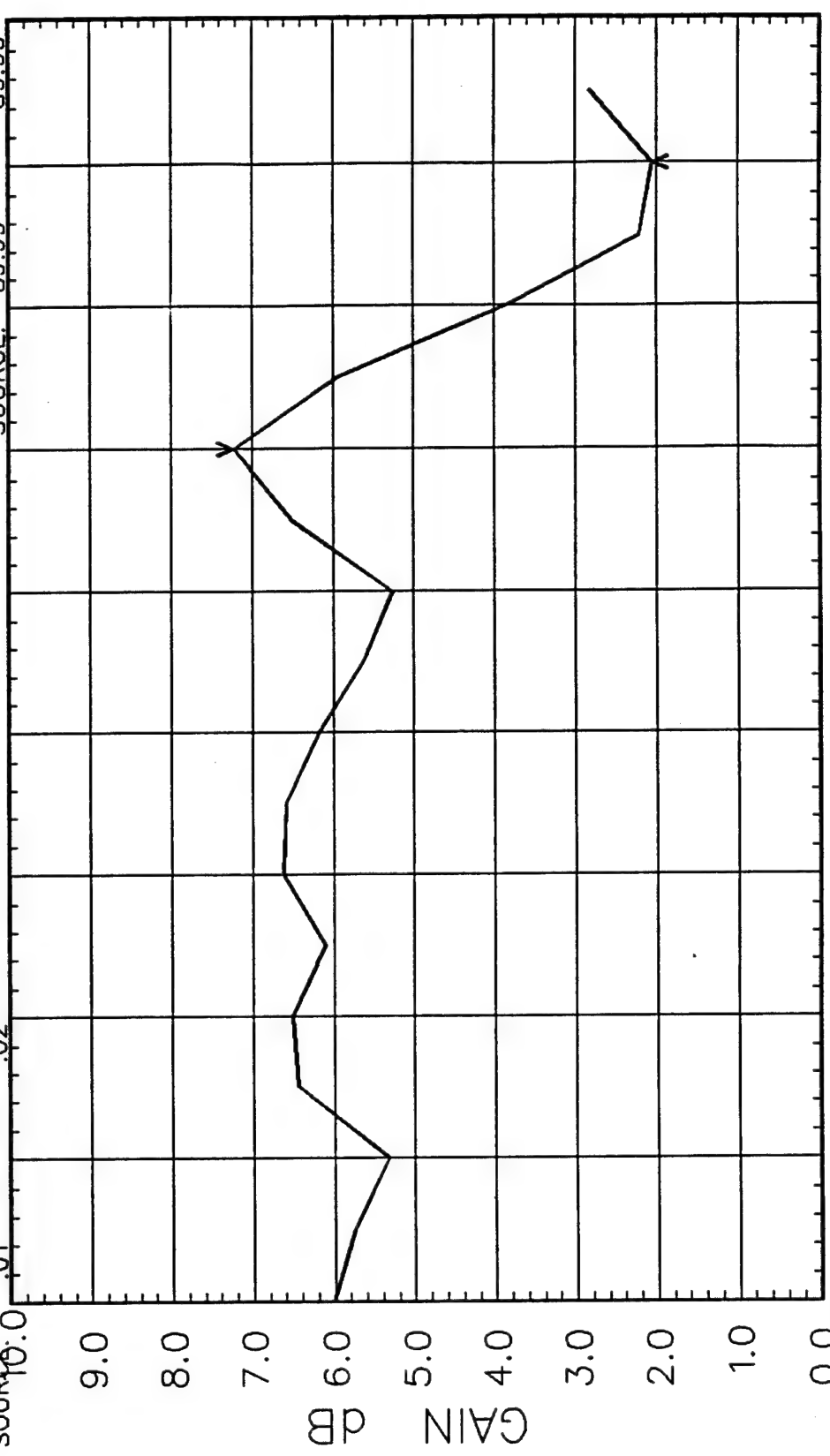
CAL FILE 1 DATA FILE 1 1/2"BELOW GP,3"BORDER

NAME: TGNTSG1
THETA: .03
PHI: -.03
SLIDE: 96.94
SOURCE: .02

18 NOV 92

TAGGANT

CAL FILE 2 DATA FILE 2
TGNTSG3 1D23IN2
NAME: THETA: .03
PHI: -.03
SLIDE: 96.94
SOURCE: 89.99



MAX 7.23 AT 370
MIN 2.05 AT 410

FREQUENCY MHZ

OUTPUT FILE: TAGGANT

SGH IS AEL 250-500
BALL AEROSPACE

```

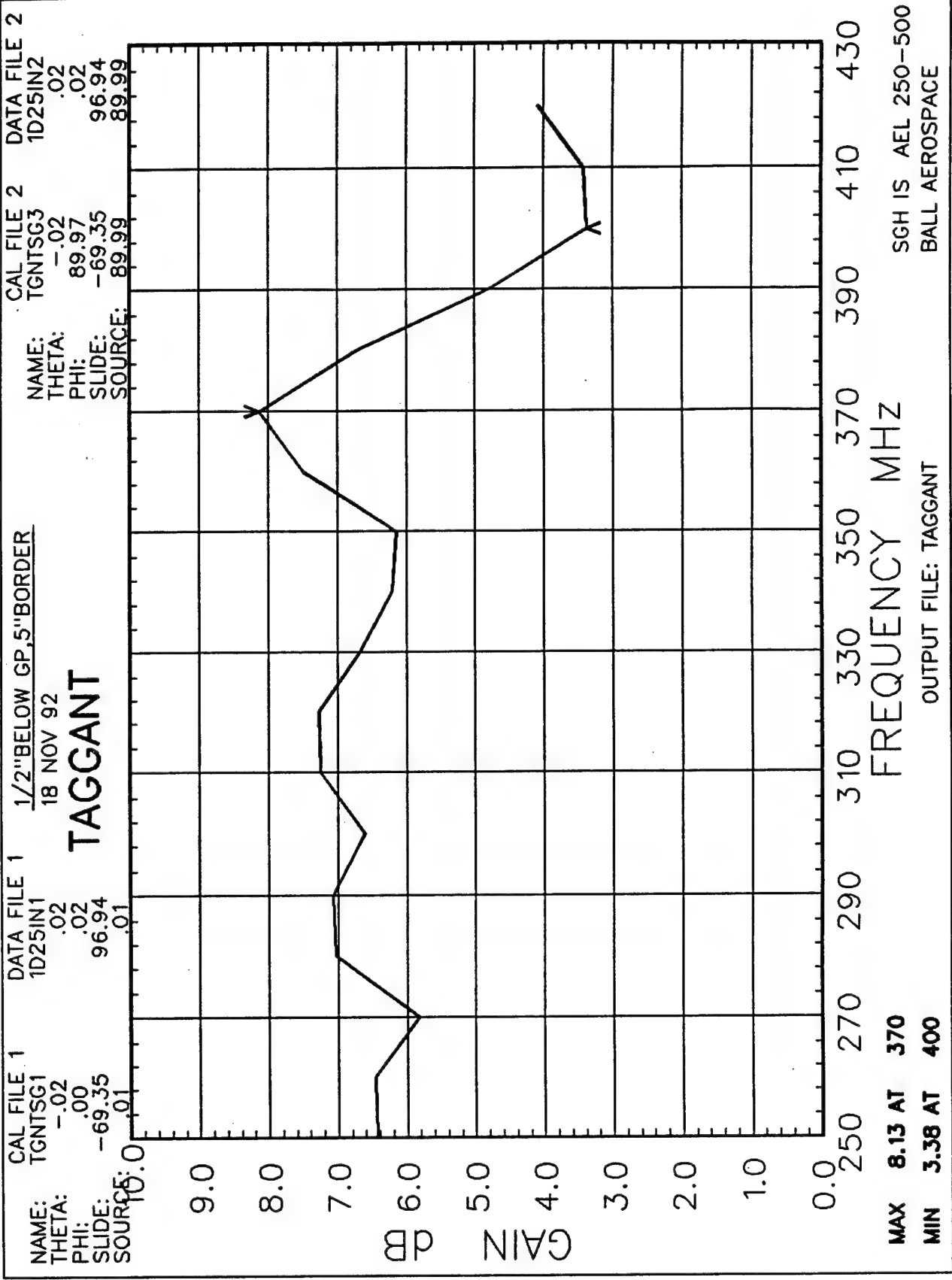
*****
*
*               TAGGANT
* 1/2"BELOW GP,3"BORDER      18 NOV 92
* CAL FILE #1 : TGNTSG1
*   THETA ANGLE:  -.02      PHI ANGLE:      .00
*   SLIDE ANGLE: -69.35     SOURCE ANGLE:    .01
*
* CAL FILE #2 : TGNTSG3
*   THETA ANGLE:  -.02      PHI ANGLE:      89.97
*   SLIDE ANGLE: -69.35     SOURCE ANGLE:    89.99
*
* DATA FILE #1 :1D23IN1
*   THETA ANGLE:   .03      PHI ANGLE:      -.03
*   SLIDE ANGLE:  96.94     SOURCE ANGLE:    .02
*
* DATA FILE #2 :1D23IN2
*   THETA ANGLE:   .03      PHI ANGLE:      -.03
*   SLIDE ANGLE:  96.94     SOURCE ANGLE:    89.99
*
* OUTPUT FILE:  TAGGANT
* GAIN STANDARD: AEL 250-500
*
*****

```

```

*****
*
*   FREQ      RHCP      LHCP      AXIAL      TILT      SGH
*   MHZ      GAIN      GAIN      RATIO      ANGLE      GAIN
* 250.      6.01      -5.40      4.79      -85.57      11.30
* 260.      5.75      -1.62      7.95      37.71      11.57
* 270.      5.32      -3.66      6.46      -37.98      11.84
* 280.      6.44      -7.44      3.56      24.01      12.11
* 290.      6.51      -6.99      3.73      87.51      12.38
* 300.      6.10      -6.17      4.32      -24.44      12.65
* 310.      6.62      -8.35      3.13      15.09      12.89
* 320.      6.59      -7.88      3.33      72.63      13.13
* 330.      6.18      -8.82      3.12      -57.87      13.37
* 340.      5.63      -13.44      1.94      -67.68      13.61
* 350.      5.26      -9.21      3.32      32.01      13.85
* 360.      6.50      -10.61      2.44      62.87      14.02
* 370.      7.23      -14.18      1.48      72.54      14.19
* 380.      5.94      -14.83      1.59      -21.23      14.36
* 390.      3.84      -15.33      1.92      -6.34      14.53
* 400.      2.20      -12.64      3.18      10.74      14.70
* 410.      2.05      -28.12      .54      49.82      14.91
* 420.      2.83      -21.54      1.05      55.06      15.12
*
*****

```



```

*****
*                                     *
*                               TAGGANT                               *
* 1/2"BELOW GP,5"BORDER      18 NOV 92                             *
* CAL FILE #1 : TGNTSG1                                           *
*   THETA ANGLE:  -.02      PHI ANGLE:      .00                    *
*   SLIDE ANGLE: -69.35     SOURCE ANGLE:    .01                    *
*                                     *
* CAL FILE #2 : TGNTSG3                                           *
*   THETA ANGLE:  -.02      PHI ANGLE:      89.97                  *
*   SLIDE ANGLE: -69.35     SOURCE ANGLE:    89.99                  *
*                                     *
* DATA FILE #1 :1D25IN1                                           *
*   THETA ANGLE:   .02      PHI ANGLE:      .02                    *
*   SLIDE ANGLE:  96.94     SOURCE ANGLE:    .01                    *
*                                     *
* DATA FILE #2 :1D25IN2                                           *
*   THETA ANGLE:   .02      PHI ANGLE:      .02                    *
*   SLIDE ANGLE:  96.94     SOURCE ANGLE:    89.99                  *
*                                     *
* OUTPUT FILE:  TAGGANT                                           *
* GAIN STANDARD: AEL 250-500                                       *
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*                                     *
* FREQ      RHCP      LHCP      AXIAL      TILT      SGH          *
* MHz       GAIN      GAIN      RATIO     ANGLE     GAIN          *
* 250.      6.44      -7.37      3.59     -74.31     11.30         *
* 260.      6.46      -3.55      5.68      38.78     11.57         *
* 270.      5.82      -3.13      6.49     -33.48     11.84         *
* 280.      7.03     -10.64      2.28      24.65     12.11         *
* 290.      7.08      -7.70      3.21     -81.36     12.38         *
* 300.      6.60      -4.97      4.69     -21.59     12.65         *
* 310.      7.25     -10.09      2.37      14.62     12.89         *
* 320.      7.27      -8.54      2.84      83.93     13.13         *
* 330.      6.68      -6.58      3.83     -49.79     13.37         *
* 340.      6.20     -10.46      2.57     -57.99     13.61         *
* 350.      6.14     -10.99      2.43      35.42     13.85         *
* 360.      7.49     -10.46      2.21      80.68     14.02         *
* 370.      8.13     -12.62      1.60     -82.34     14.19         *
* 380.      6.73     -10.36      2.44     -28.32     14.36         *
* 390.      4.80     -13.32      2.17     -16.44     14.53         *
* 400.      3.38     -12.81      2.72       7.01     14.70         *
* 410.      3.42     -19.96      1.18     -72.78     14.91         *
* 420.      4.08     -17.45      1.46     -84.33     15.12         *
*                                     *
*****

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1/8"BELOW GP,1"BORDER
18 NOV 92

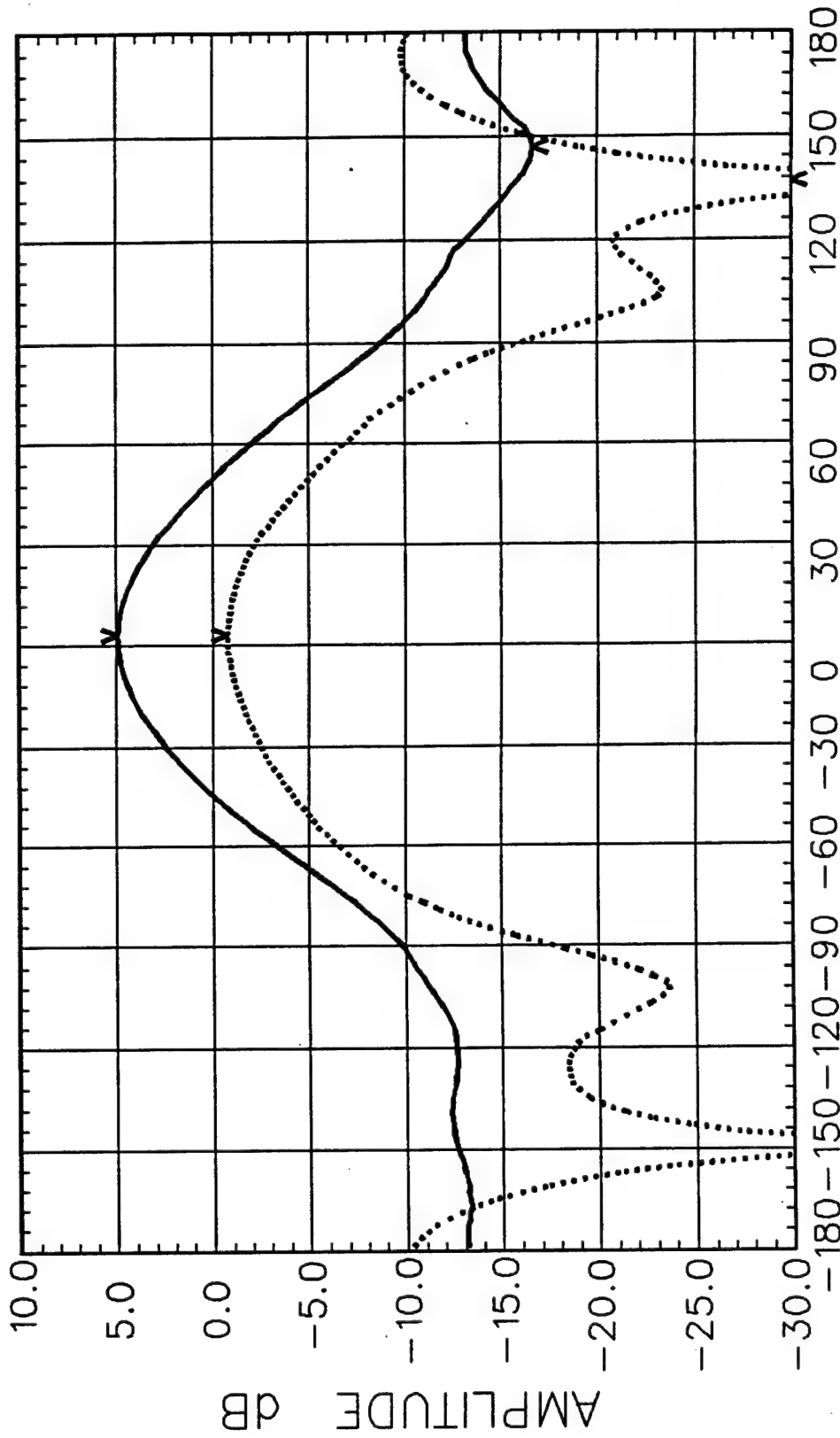
TAGCANT

BALL AEROSPACE

— is 260MHz RHCP GAIN PHI=
..... is 260MHz LHCP GAIN PHI=

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

CP6241 HAS 15dB IF ATTEN
CP6241 HAS 15dB IF ATTEN



MAX: 4.91dB at 3deg MIN: -16.66dB at 147deg
MAX: -1.80dB at 3deg MIN: -40.80dB at 137deg

1) REFLECTOR MAY 92
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100) REFLECTOR MAY 92

1/8"BELOW GP, 1" BORDER

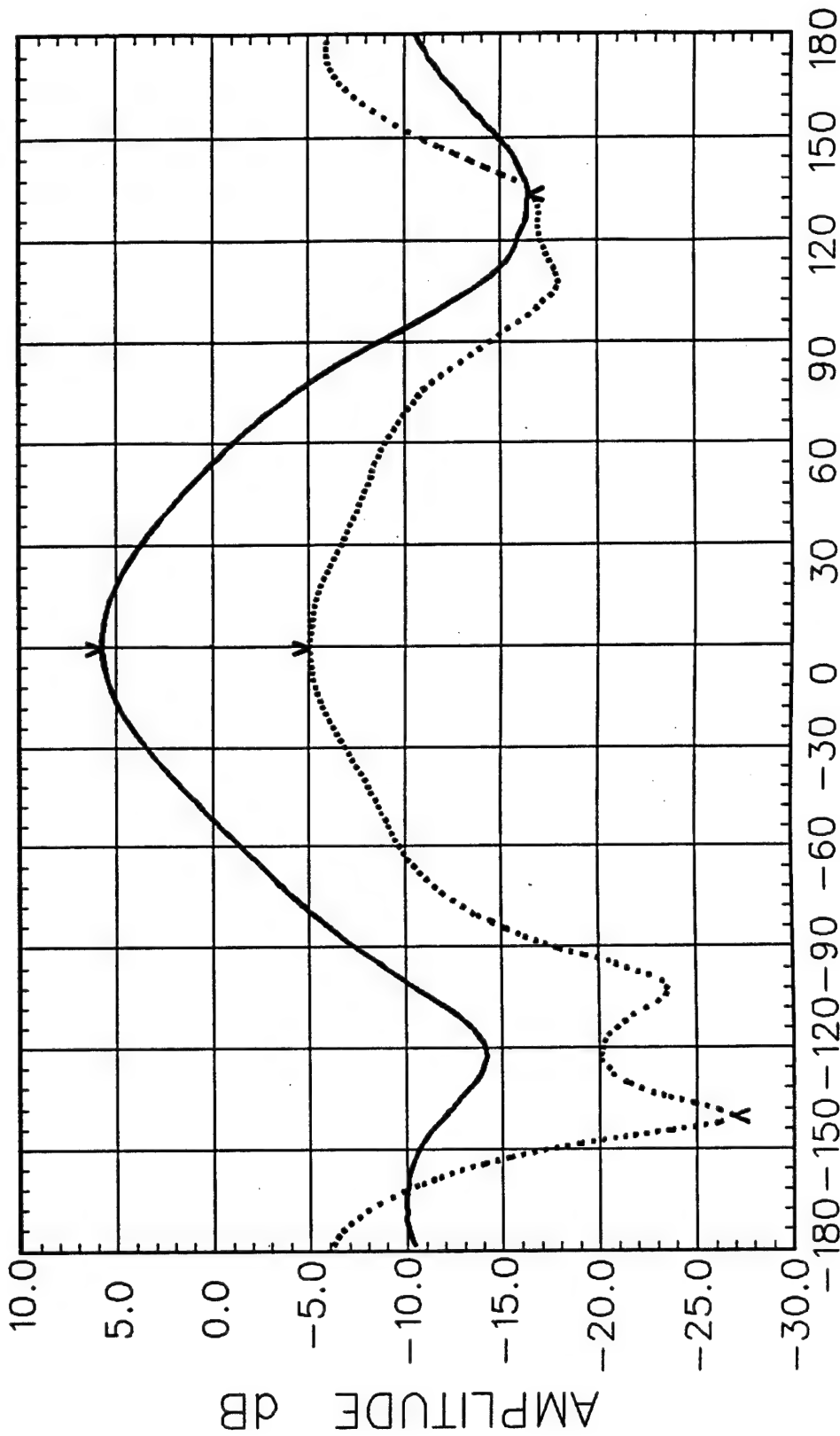
TAGGANT

BALL AEROSPACE

18 NOV 92

— is 290MHz RHCP GAIN PHI= 0deg
..... is 290MHz LHCP GAIN PHI= 0deg

CP6242 HAS 15dB IF ATTEN
CP6242 HAS 15dB IF ATTEN



— MAX: 5.75dB at -1deg MIN: -16.44dB at 133deg
..... MAX: -5.01dB at -1deg MIN: -26.91dB at 141deg

2) RFL07:19 MAY 92 CPXFN:28 OCT 91
1) RFL07:19 MAY 92 CPXFN:28 OCT 91

1/8"BELOW GP,1"BORDER
18 NOV 92

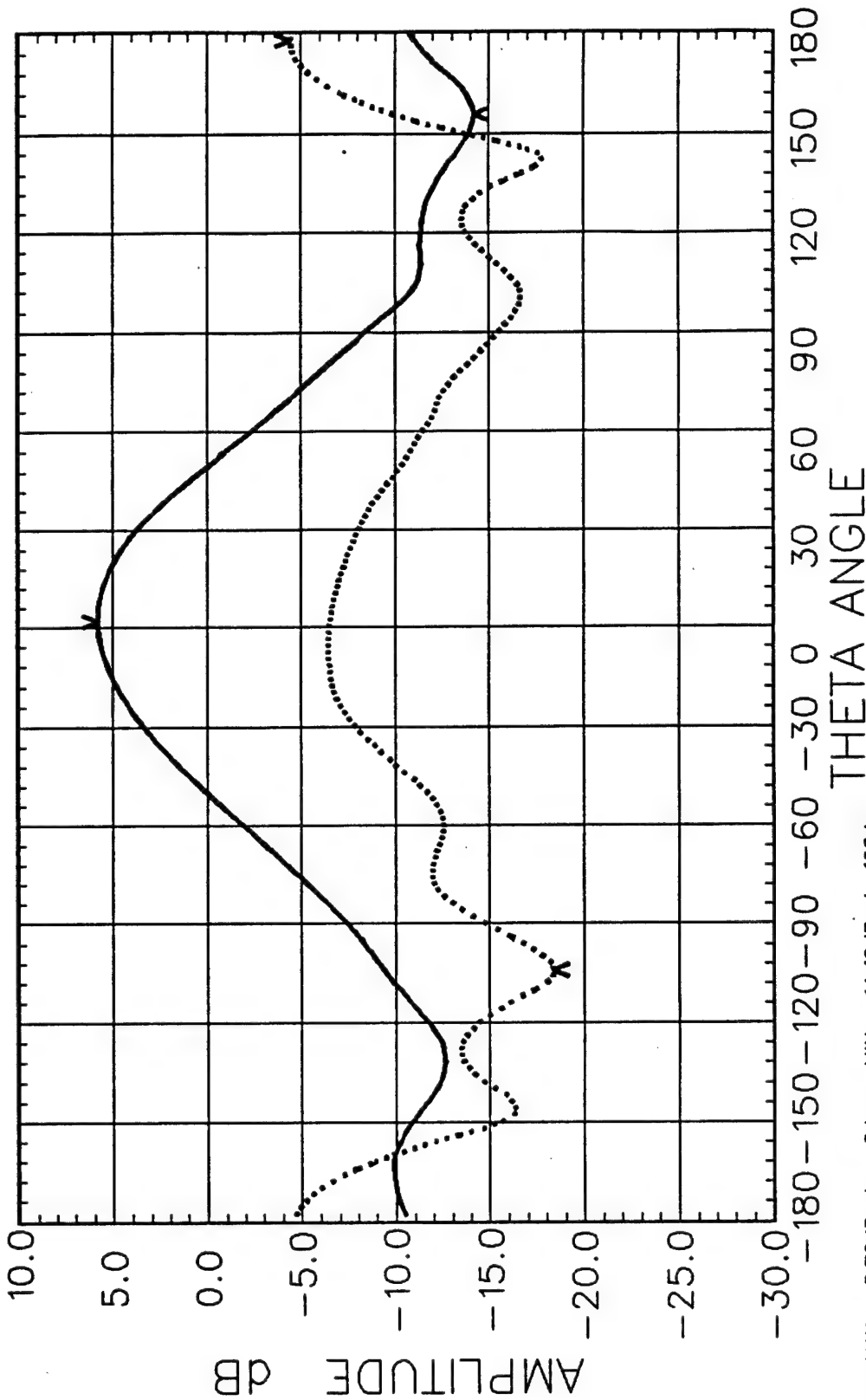
TAGGANT

BALL AEROSPACE

CP6243 HAS 15dB IF ATTEN
CP6243 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

320MHz RHCP GAIN PHI=
320MHz LHCP GAIN PHI=



MAX: 5.79dB at 2deg MIN: -14.19dB at 156deg
MAX: -4.46dB at 178deg MIN: -18.37dB at -104deg

2) RPLUT: 19 MAY 92
CP6243: 28 OCT 91

1/8"BELOW GP,1"BORDER
18 NOV 92

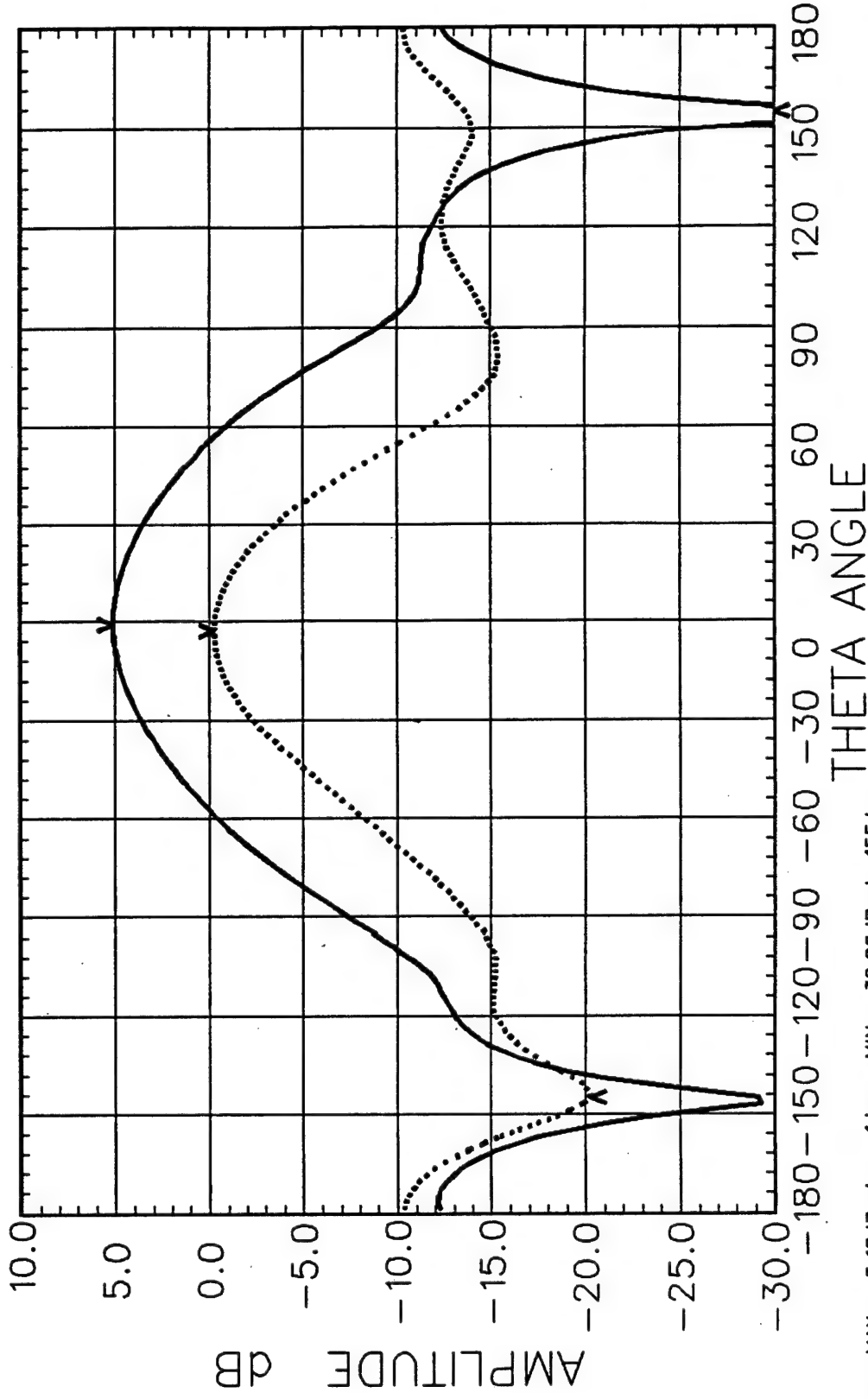
TAGGANT

BALL AEROSPACE

CP6261 HAS 15dB IF ATTEN
CP6261 HAS 15dB IF ATTEN

260MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
260MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE

— is
..... is



— MAX: 5.10dB at -1deg MIN: -39.06dB at 155deg
..... MAX: -29.30dB at -3deg MIN: -20.30dB at -145deg

2) REF: 18 MAY 92
3) REF: 28 OCT 91

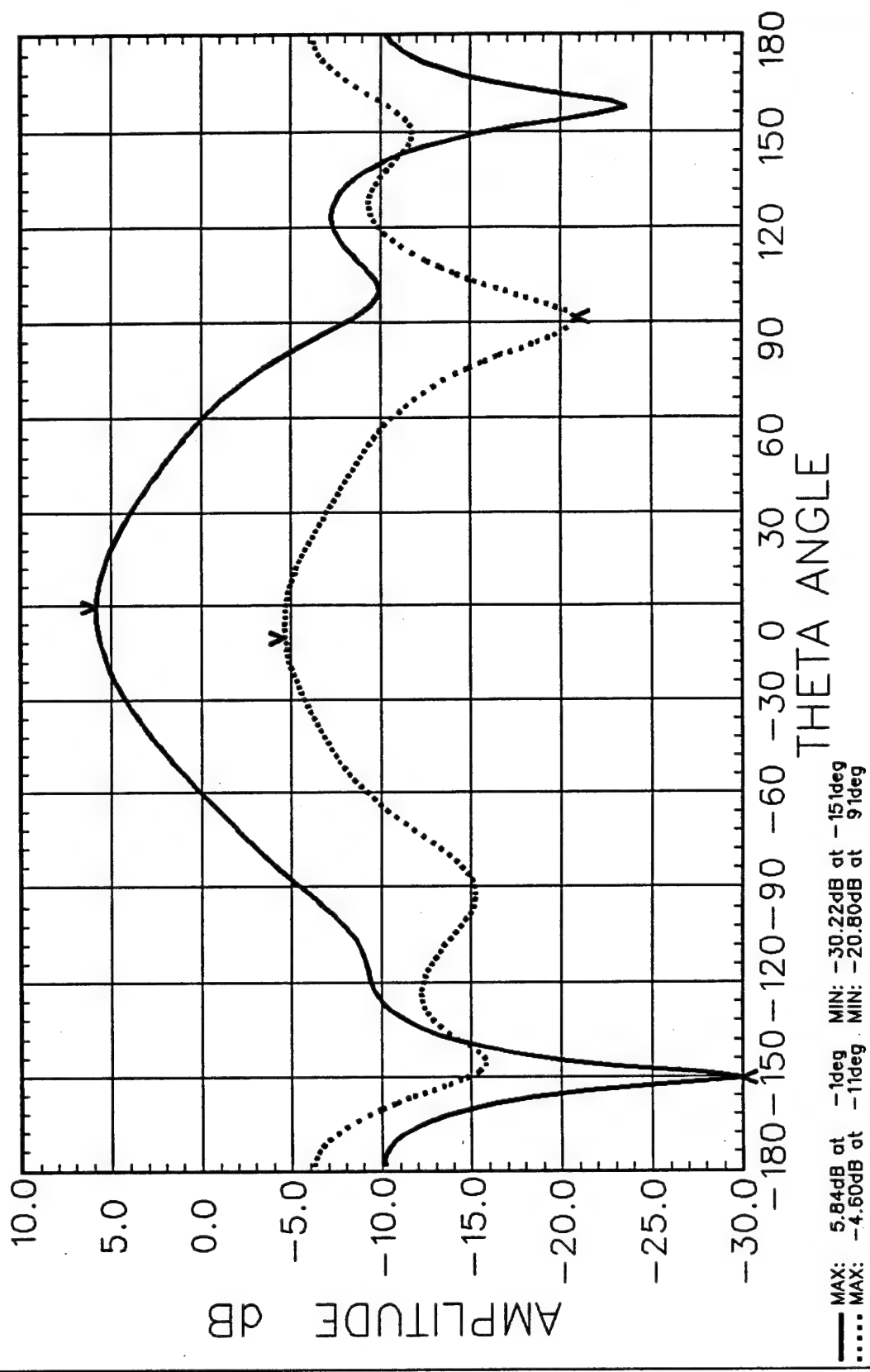
1/8"BELOW GP, 1" BORDER
18 NOV 92

TAGGANT

CP6262 HAS 15dB IF ATTEN
CP6262 HAS 15dB IF ATTEN

— is 290MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 290MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE

BALL AEROSPACE



1) RELOT:19 MAY 92
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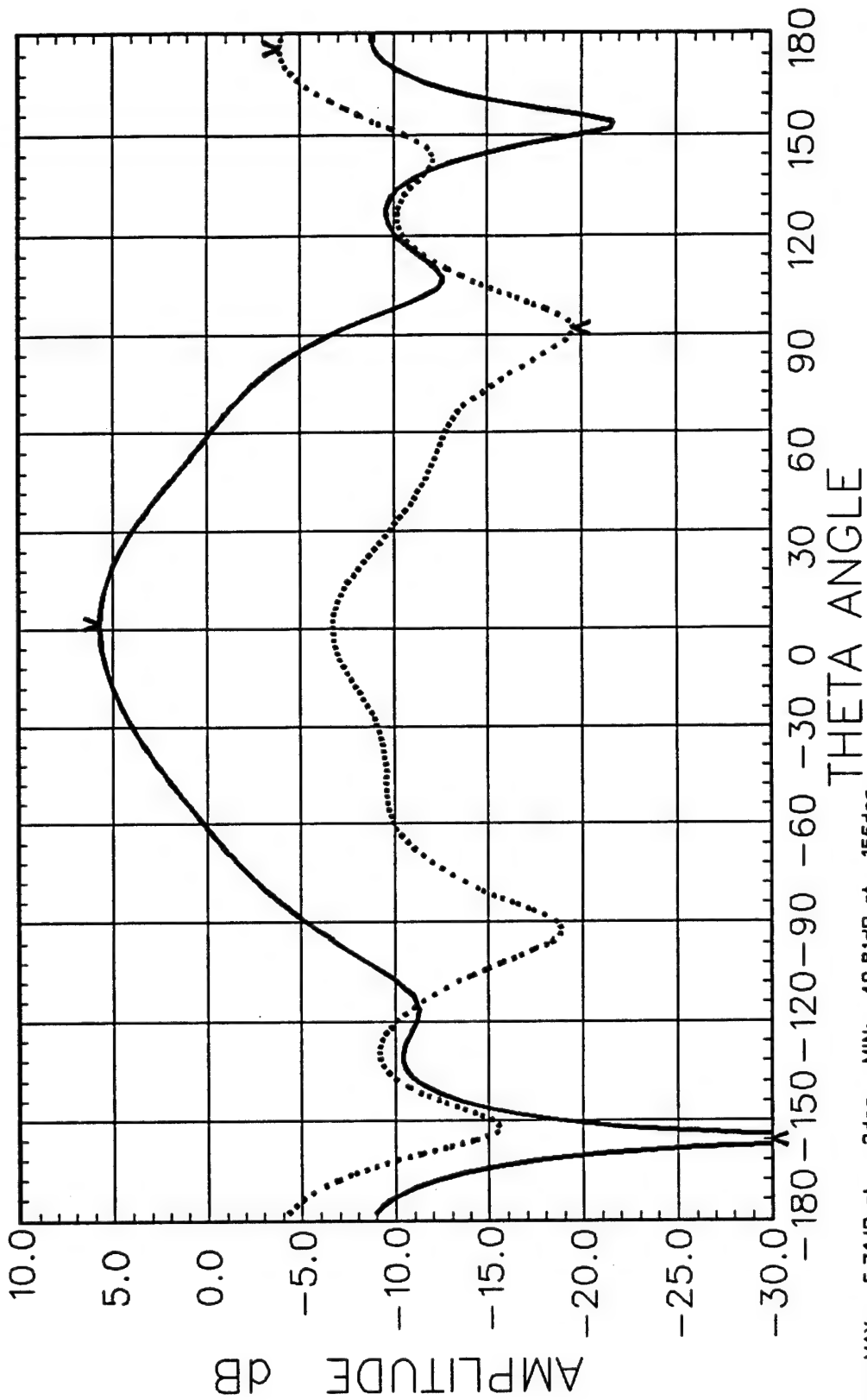
1/8"BELOW GP,1"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6263 HAS 15dB IF ATTEN
CP6263 HAS 15dB IF ATTEN

— is 320MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 320MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



— MAX: 5.71dB at 2deg MIN: -40.81dB at -156deg
..... MAX: -3.87dB at 176deg MIN: -19.65dB at 92deg

18 NOV 92
CP6263 HAS 15dB IF ATTEN
CP6263 HAS 15dB IF ATTEN

1/8"BELOW GP,2"BORDER

18 NOV 92

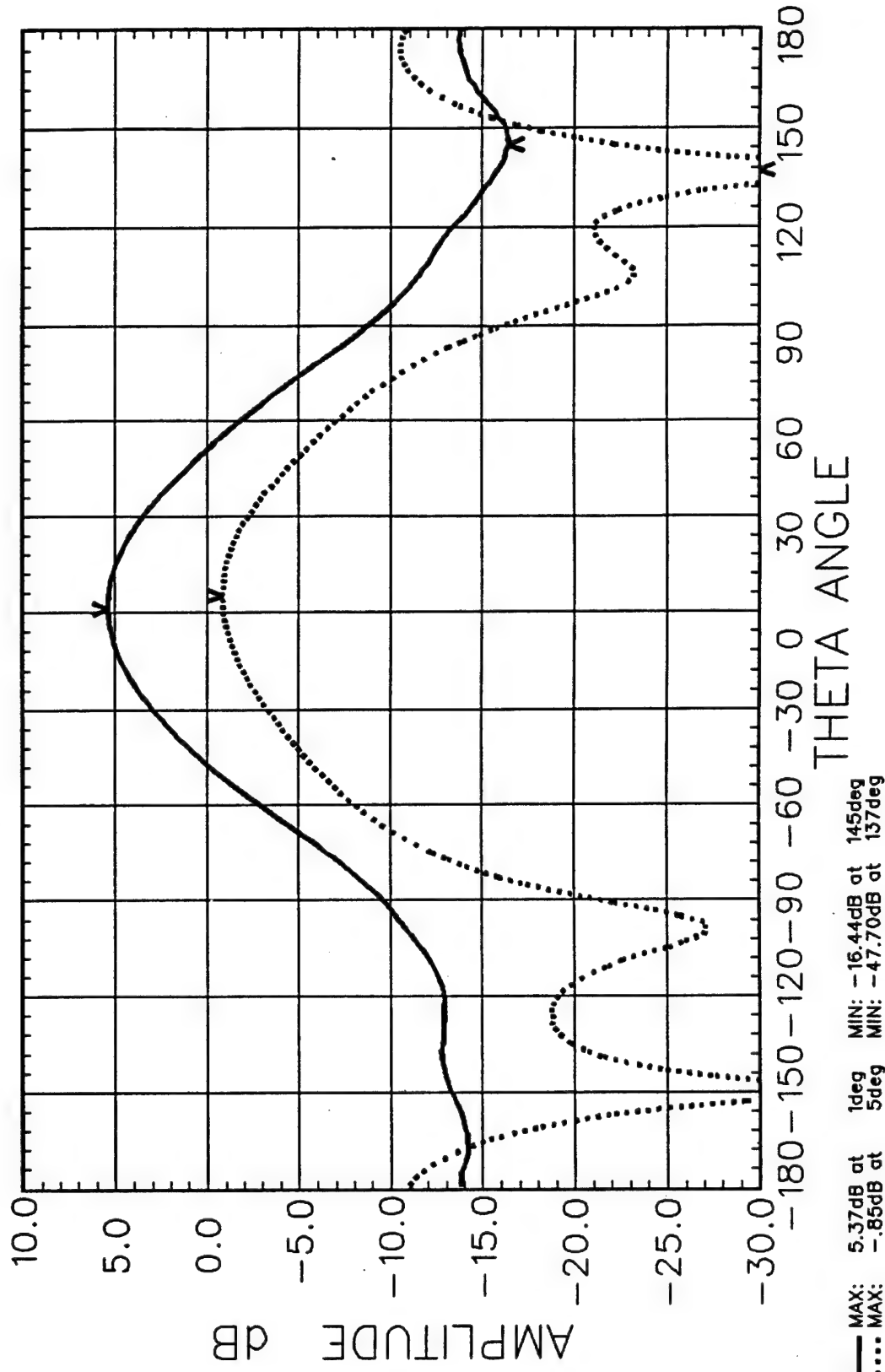
is 260MHz RHCP GAIN PHI=
..... is 260MHz LHCP GAIN PHI=

TAGGANT

Odeg ABSOLUTE AMPLITUDE
Odeg ABSOLUTE AMPLITUDE

CP6281 HAS 15dB IF ATTEN
CP6281 HAS 15dB IF ATTEN

BALL AEROSPACE



MAX: 5.37dB at 1deg MIN: -16.44dB at 145deg
MAX: -.85dB at 5deg MIN: -47.70dB at 137deg

2) REPORT: 18 MAY 92
3) REPORT: 18 MAY 92
CP6281: 28 OCT 91

1/8"BELOW GP.2"BOARD

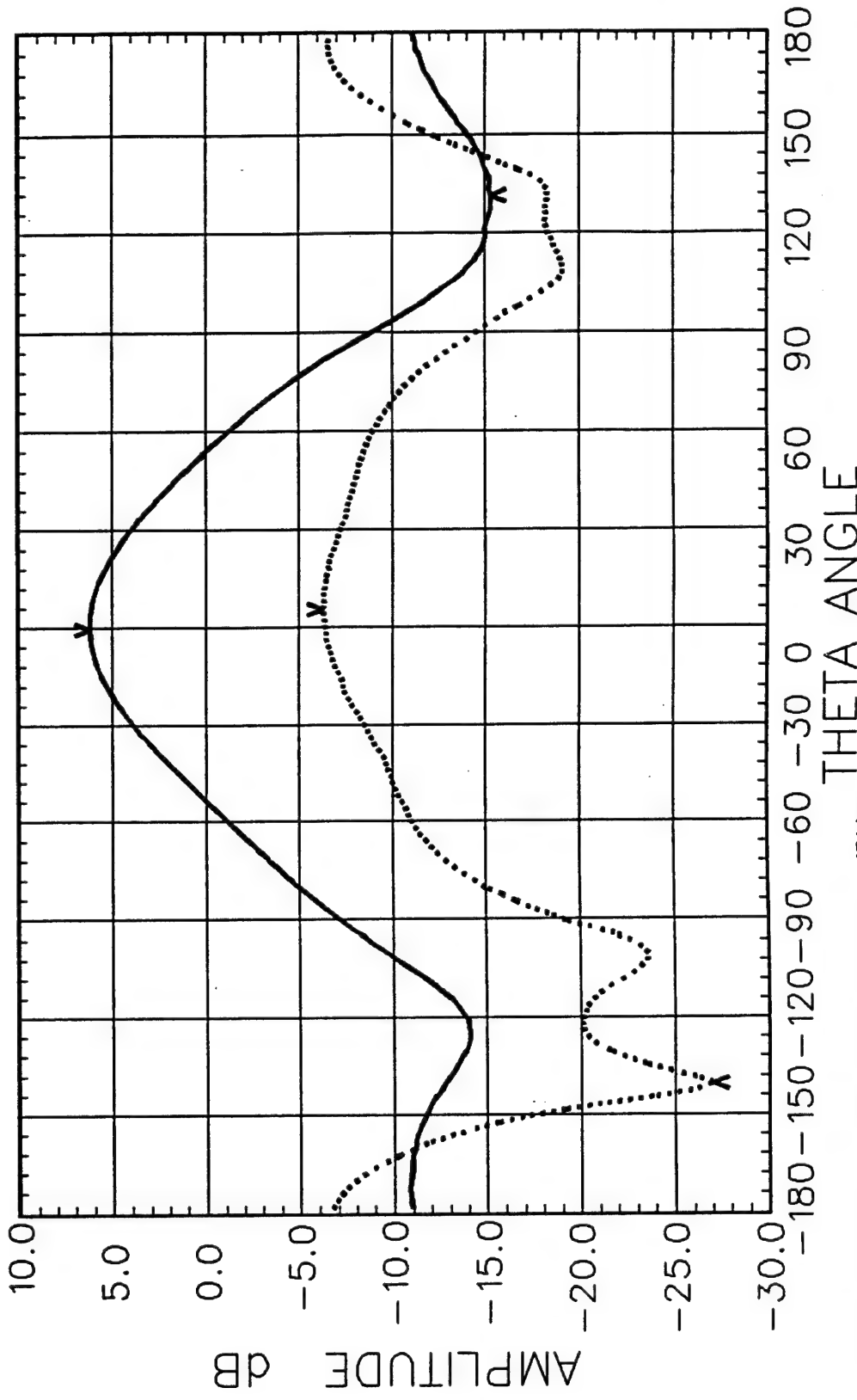
TAGGANT

BALL AEROSPACE

18 NOV 92

— is 290MHz RHCP GAIN PHI= 0deg ABSOLUTE AMPLITUDE
..... is 290MHz LHCP GAIN PHI= 0deg ABSOLUTE AMPLITUDE

CP6282 HAS 15dB IF ATTEN
CP6282 HAS 15dB IF ATTEN



— MAX: 6.17dB at -1deg MIN: -15.30dB at 131deg
..... MAX: -6.27dB at 5deg MIN: -27.05dB at -141deg

2) REFLECTOR MAY 92 CP174-28 OCT 91
3) REFLECTOR MAY 92 CP174-28 OCT 91

1/8"BELOW GP.2"BORDER
18 NOV 92

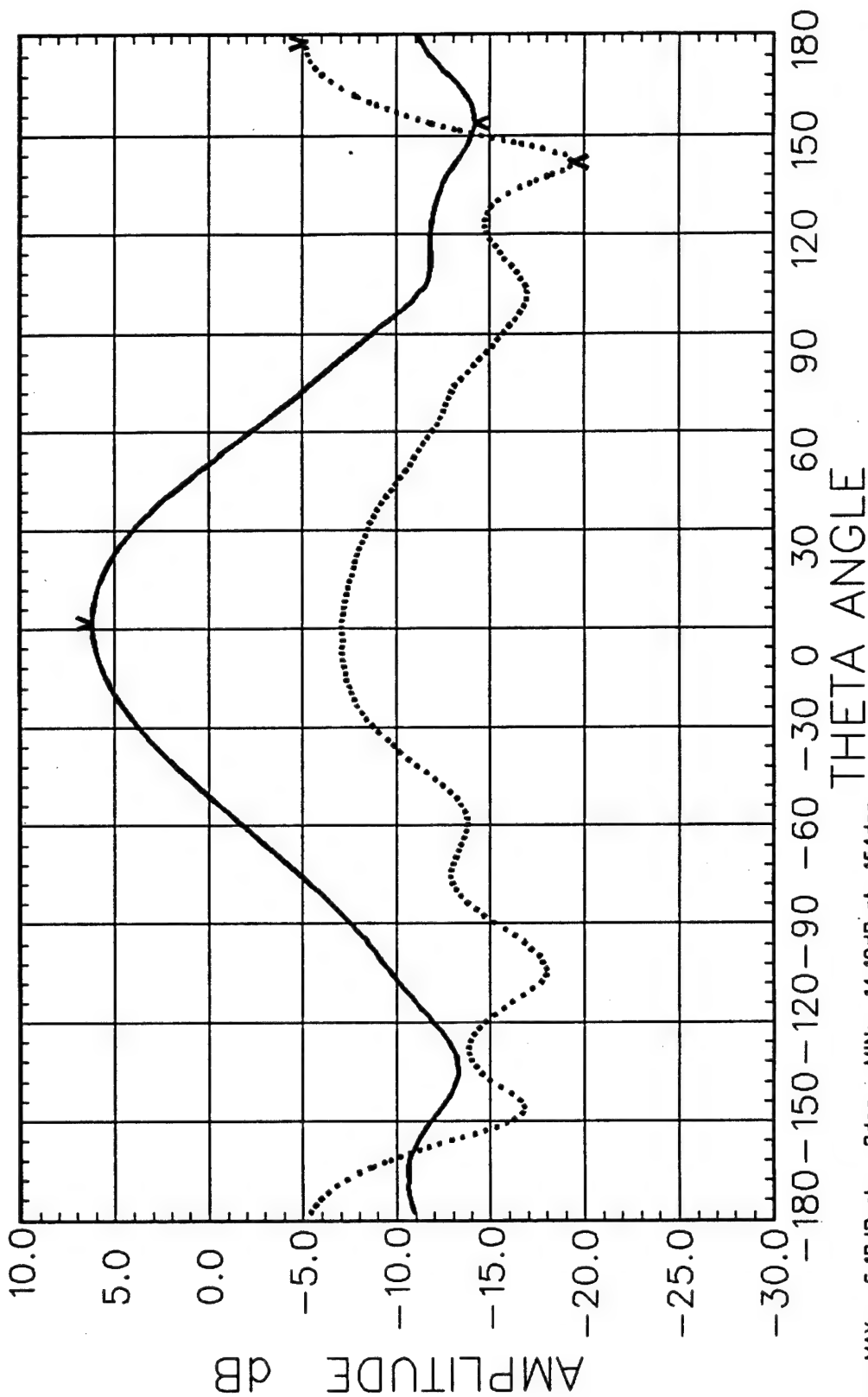
TAGGANT

BALL AEROSPACE

— is 320MHz RHCP GAIN PHI=
..... is 320MHz LHCP GAIN PHI=

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

CP6283 HAS 15dB IF ATTEN
CP6283 HAS 15dB IF ATTEN



— MAX: 6.18dB at 2deg MIN: -14.19dB at 154deg
..... MAX: -5.15dB at 178deg MIN: -19.39dB at 142deg

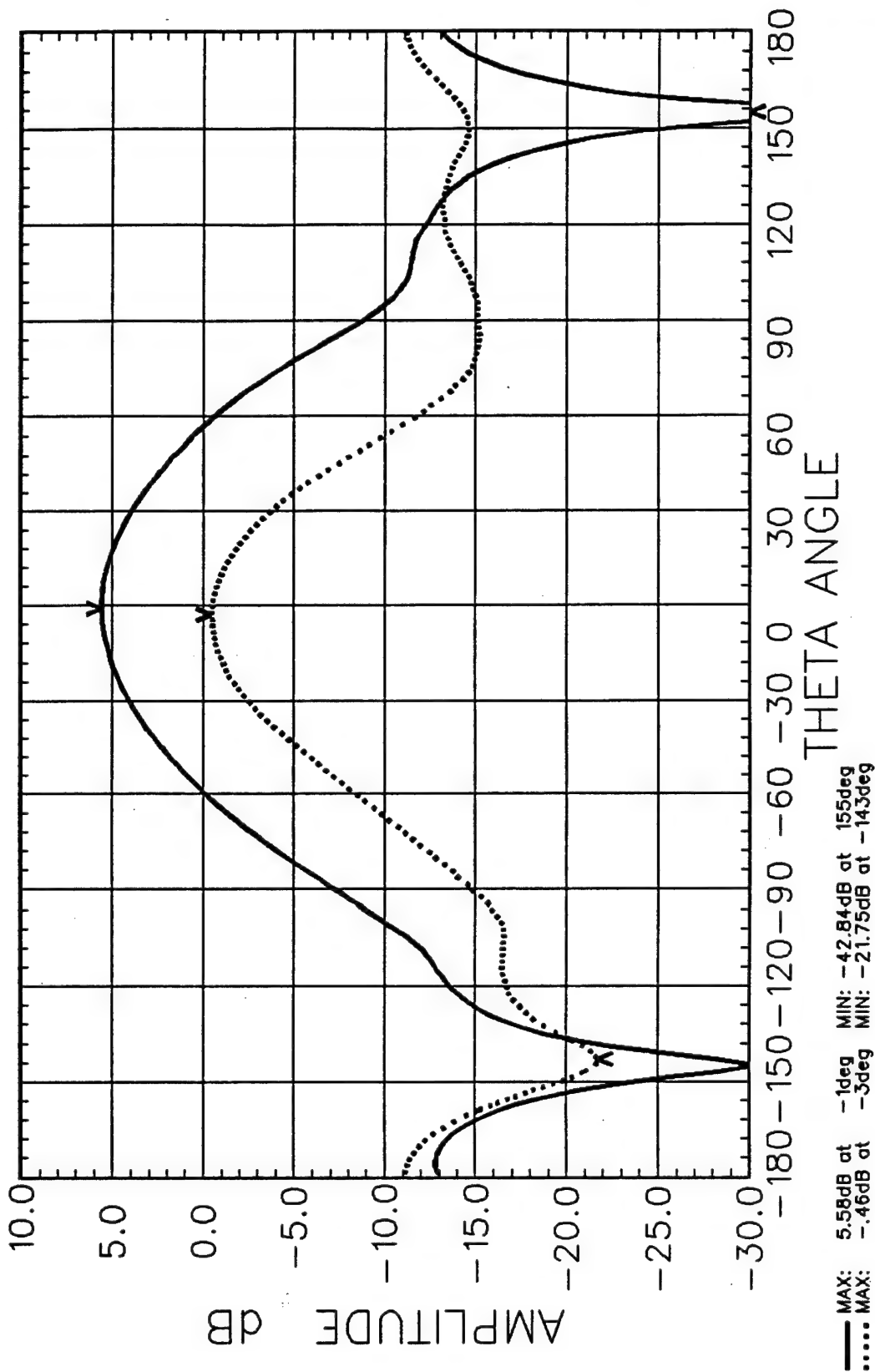
1/8"BELOW GP,2"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

— is 260MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 260MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE

CP6301 HAS 15dB IF ATTEN
CP6301 HAS 15dB IF ATTEN



1/8"BELOW GP,2"BORDER

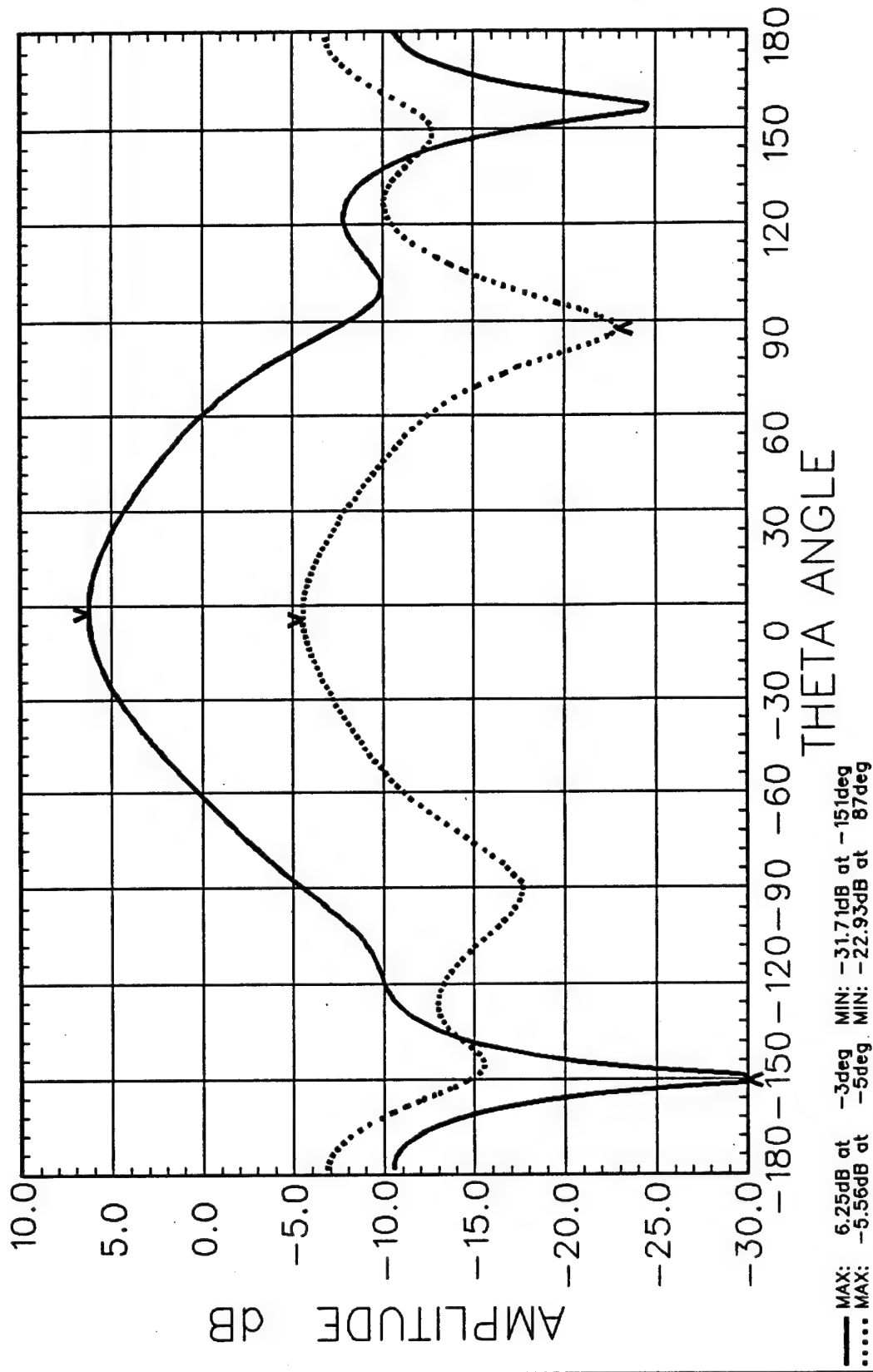
TAGGANT

BALL AEROSPACE

18 NOV 92

— is 290MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 290MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE

CP6302 HAS 15dB IF ATTEN
CP6302 HAS 15dB IF ATTEN



1) RECD:19 MAY 92 CP6302:28 OCT 91
2) RECD:19 MAY 92 CP6302:28 OCT 91

1/8"BELOW GP,2"BORDER

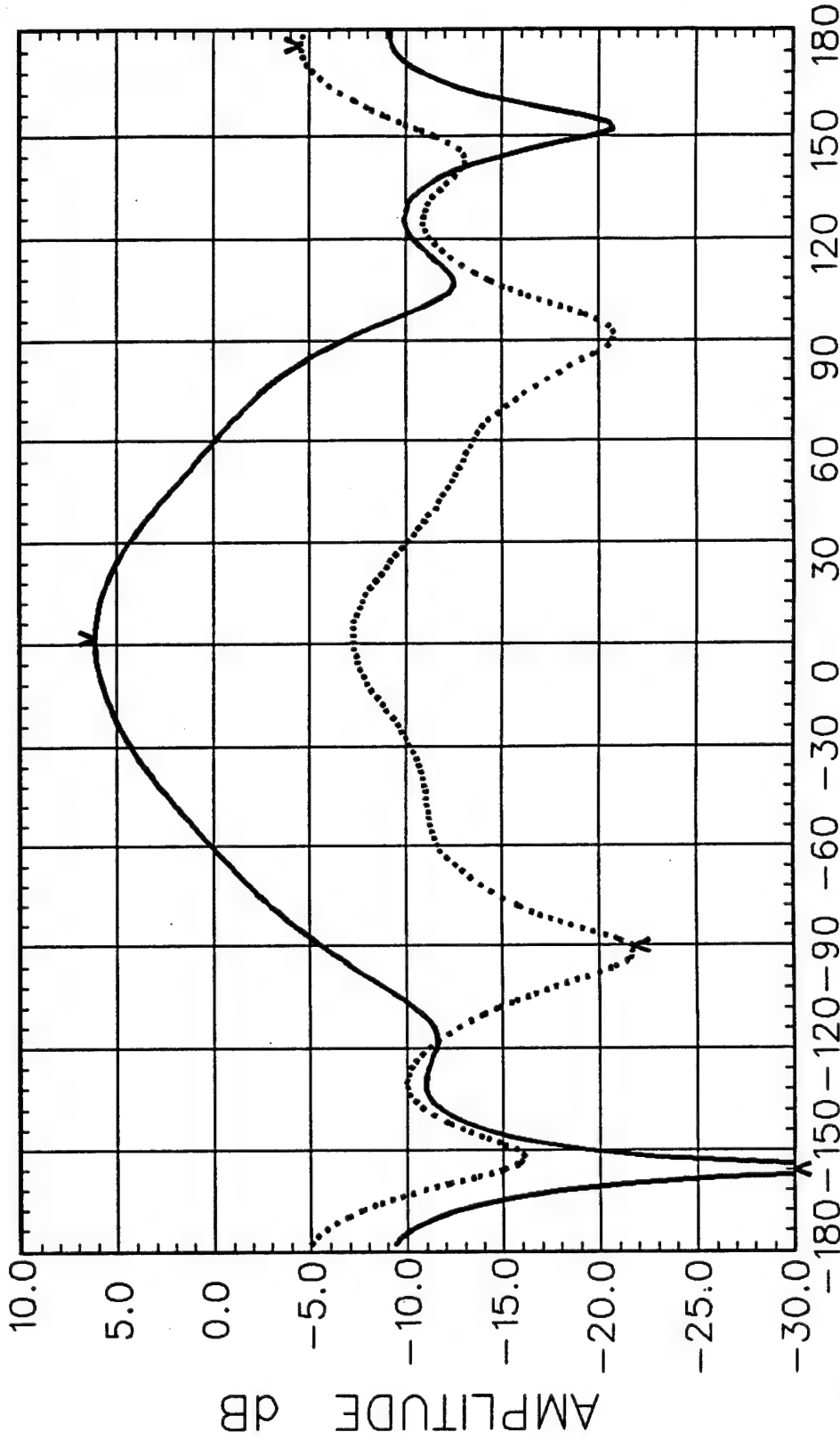
TAGGANT

BALL AEROSPACE

18 NOV 92

— is 320MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 320MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE

CP6303 HAS 15dB IF ATTEN
CP6303 HAS 15dB IF ATTEN



THETA ANGLE

— MAX: 6.12dB at 2deg MIN: -36.86dB at -156deg
..... MAX: -4.54dB at 176deg MIN: -21.78dB at -90deg

CP6303 HAS 15dB IF ATTEN
CP6303 HAS 15dB IF ATTEN
CP6303 HAS 15dB IF ATTEN
CP6303 HAS 15dB IF ATTEN

1/8"BELOW GP,3"BORDER
18 NOV 92

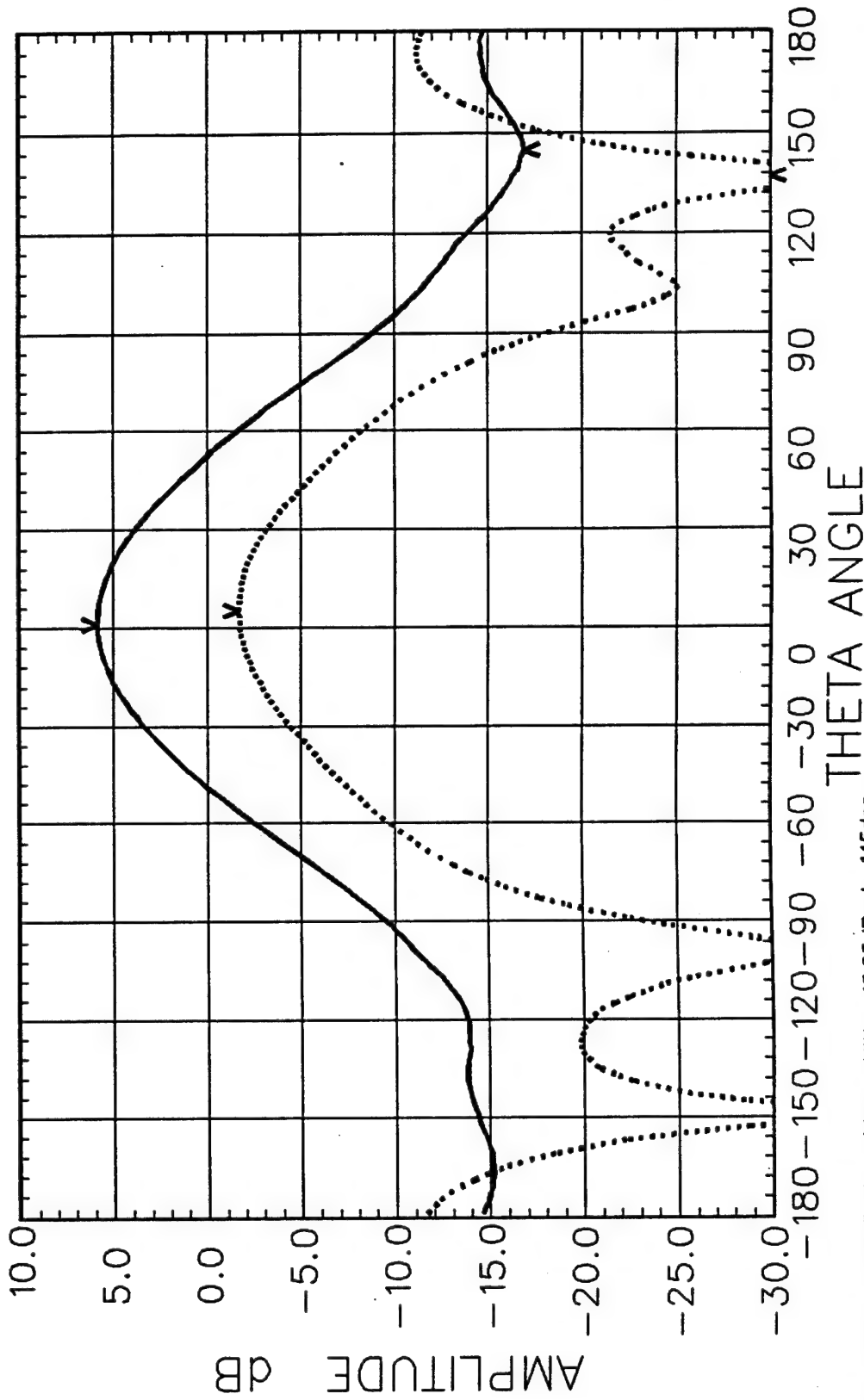
TAGCANT

BALL AEROSPACE

CP6321 HAS 15dB IF ATTEN
CP6321 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

260MHz RHCP GAIN PHI=
260MHz LHCP GAIN PHI=



MAX: 5.84dB at 1deg MIN: -16.93dB at 145deg
MAX: -1.69dB at 5deg MIN: -40.04dB at 137deg

2) RFLUT:3 MAY 92 02:14:28 OCT 91
1) RFLUT:3 MAY 92 02:14:28 OCT 91

1/8"BELOW GP,3"BORDER
18 NOV 92

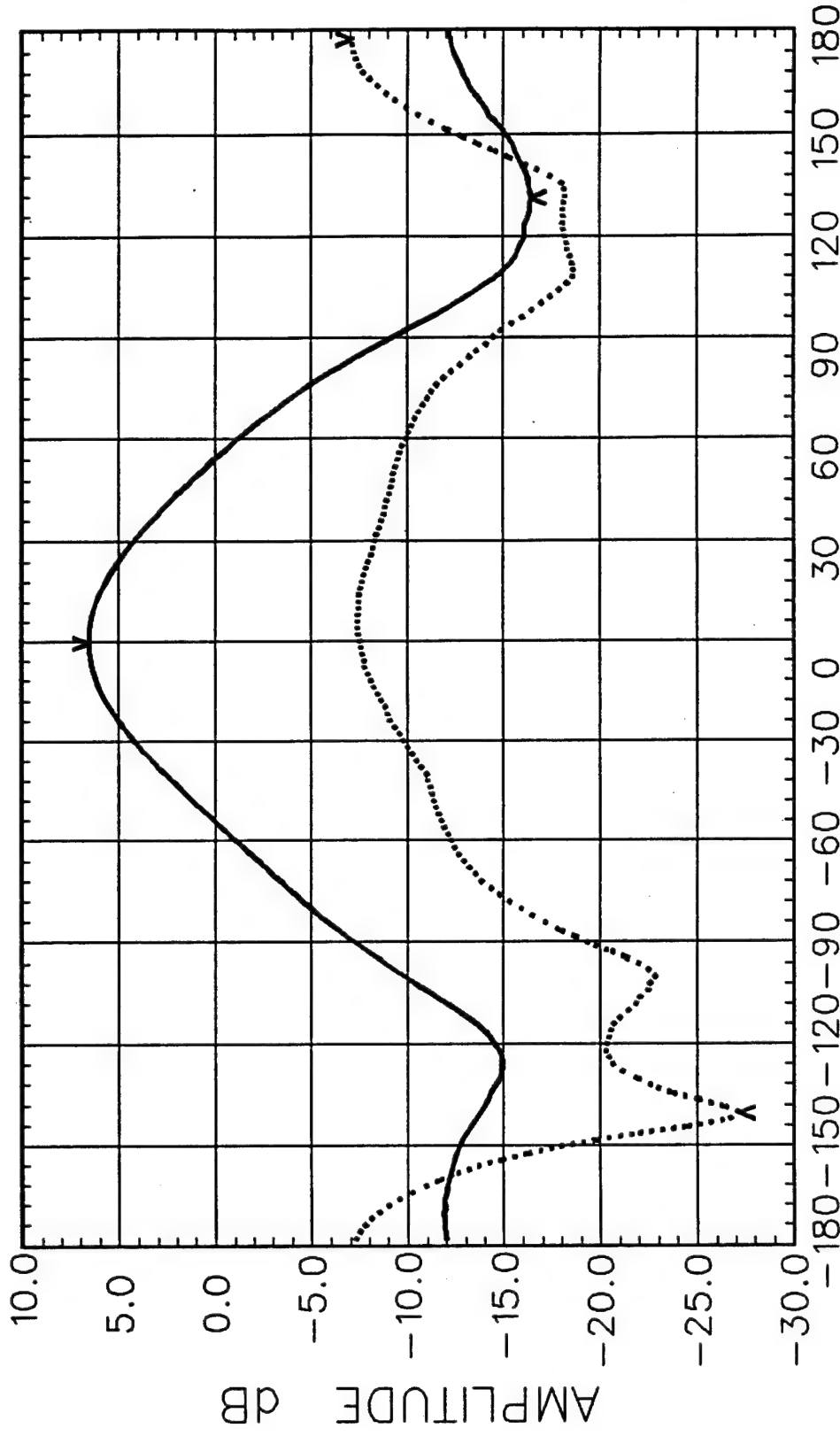
TAGGANT

BALL AEROSPACE

CP6322 HAS 15dB IF ATTEN
CP6322 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

is 290MHz RHCP GAIN PHI=
is 290MHz LHCP GAIN PHI=



THETA ANGLE

MAX: 6.54dB at -1deg MIN: -16.43dB at 131deg
MAX: -7.10dB at 177deg MIN: -27.19dB at -141deg

2) REF: 18 MAY 92
CP6322 HAS 15dB IF ATTEN
CP6322 HAS 15dB IF ATTEN

1/8"BELOW GP.3"BORDER

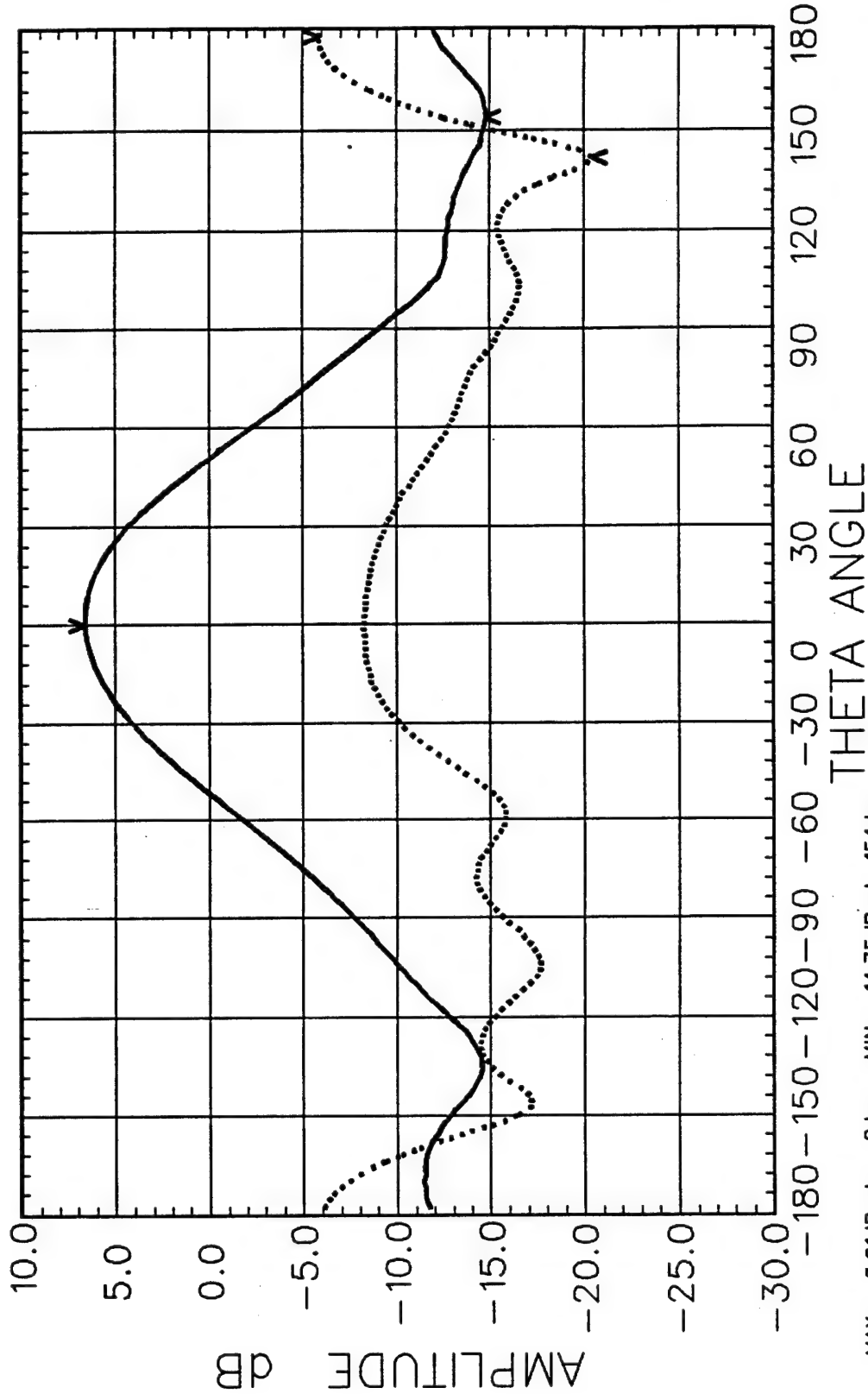
TAGGANT

BALL AEROSPACE

18 NOV 92

is 320MHz RHCP GAIN PHI=
..... is 320MHz LHCP GAIN PHI=

CP6323 HAS 15dB IF ATTEN
CP6323 HAS 15dB IF ATTEN



MAX: 6.61dB at 0deg MIN: -14.75dB at 154deg
..... MAX: -5.87dB at 178deg MIN: -20.44dB at 142deg

2) RFLUT:18 MAY 92 CPXFM:28 OCT 91
CPXFM:28 OCT 91

1/8"BELOW GP,3"BORDER
18 NOV 92

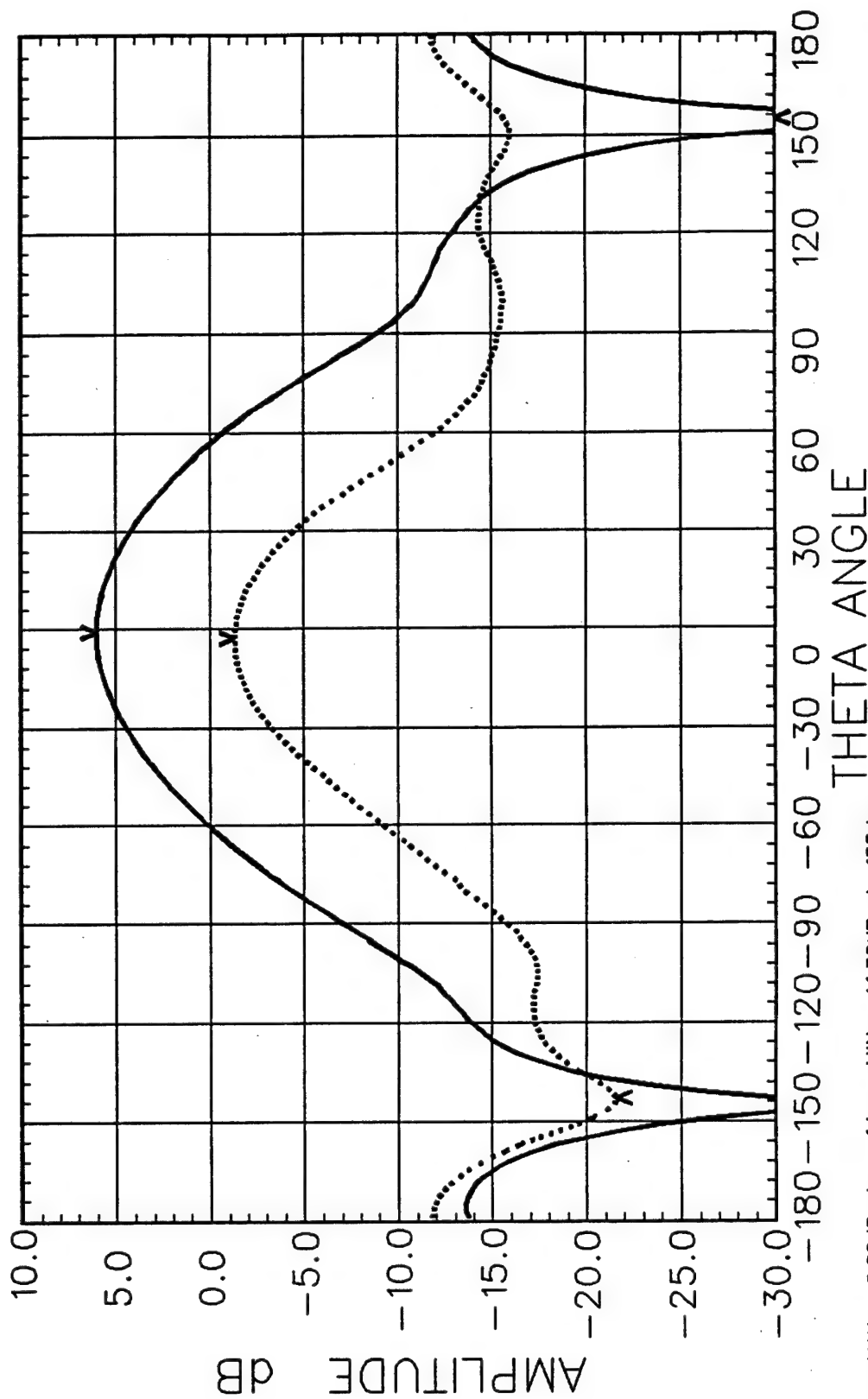
TAGGANT

BALL AEROSPACE

CP6341 HAS 15dB IF ATTEN
CP6341 HAS 15dB IF ATTEN

260MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
260MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE

— is
..... is



MAX: 6.02dB at -1deg MIN: -41.89dB at 155deg
MAX: -1.33dB at -3deg MIN: -21.59dB at -143deg

1) REPUT: 19 MAY 92
2) REPUT: 19 MAY 92
CP17M: 28 OCT 91
CP17M: 28 OCT 91

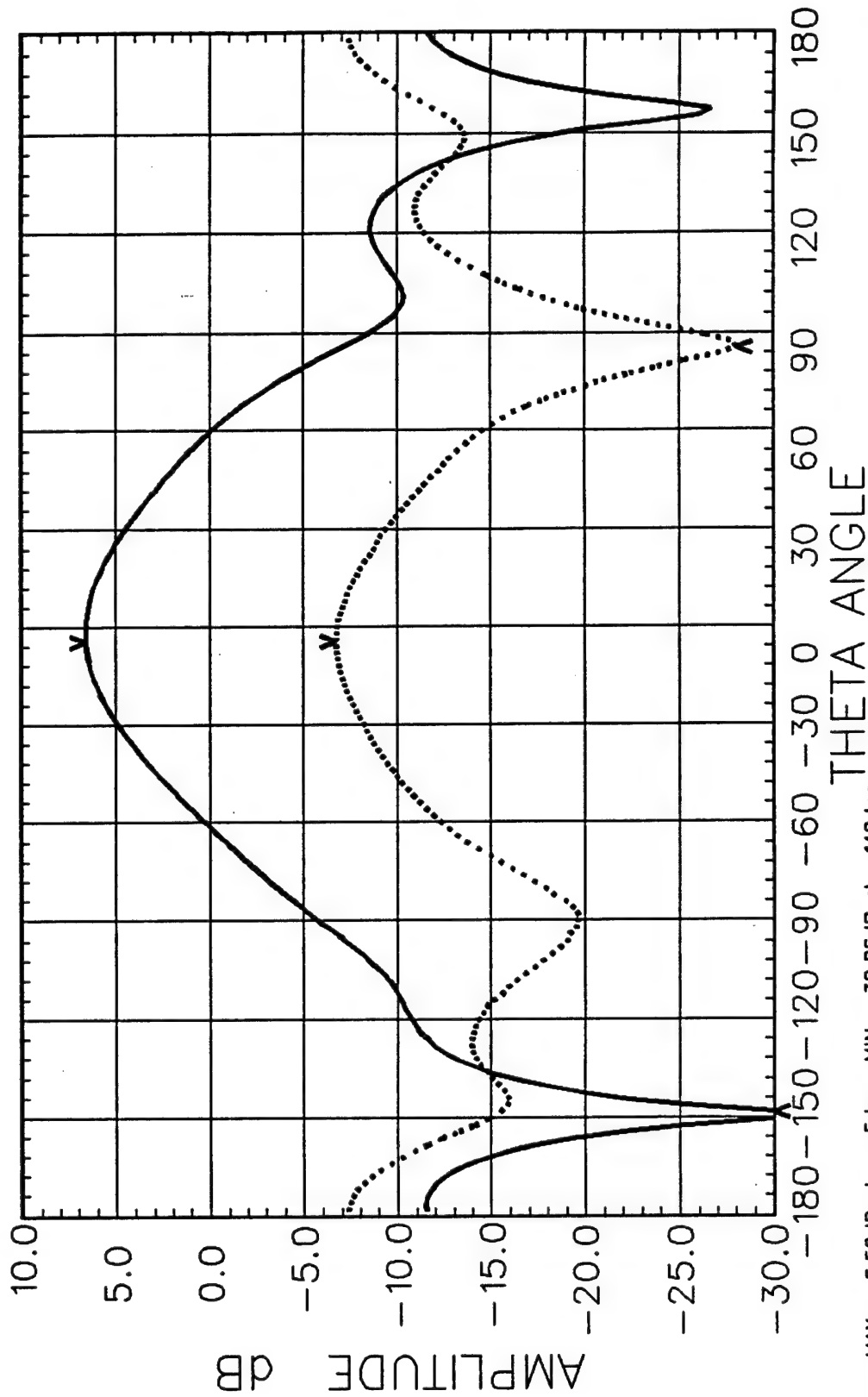
1/8"BELOW GP,3"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6342 HAS 15dB IF ATTEN
CP6342 HAS 15dB IF ATTEN

is 290MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 290MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



MAX: 6.59dB at -5deg MIN: -30.86dB at -149deg
MAX: -6.74dB at -5deg MIN: -28.09dB at 85deg

2) RPLUT:19 MAY 92
CPXN:28 OCT 91
CPXN:28 OCT 91

1/8"BELOW GP.3"BORDER

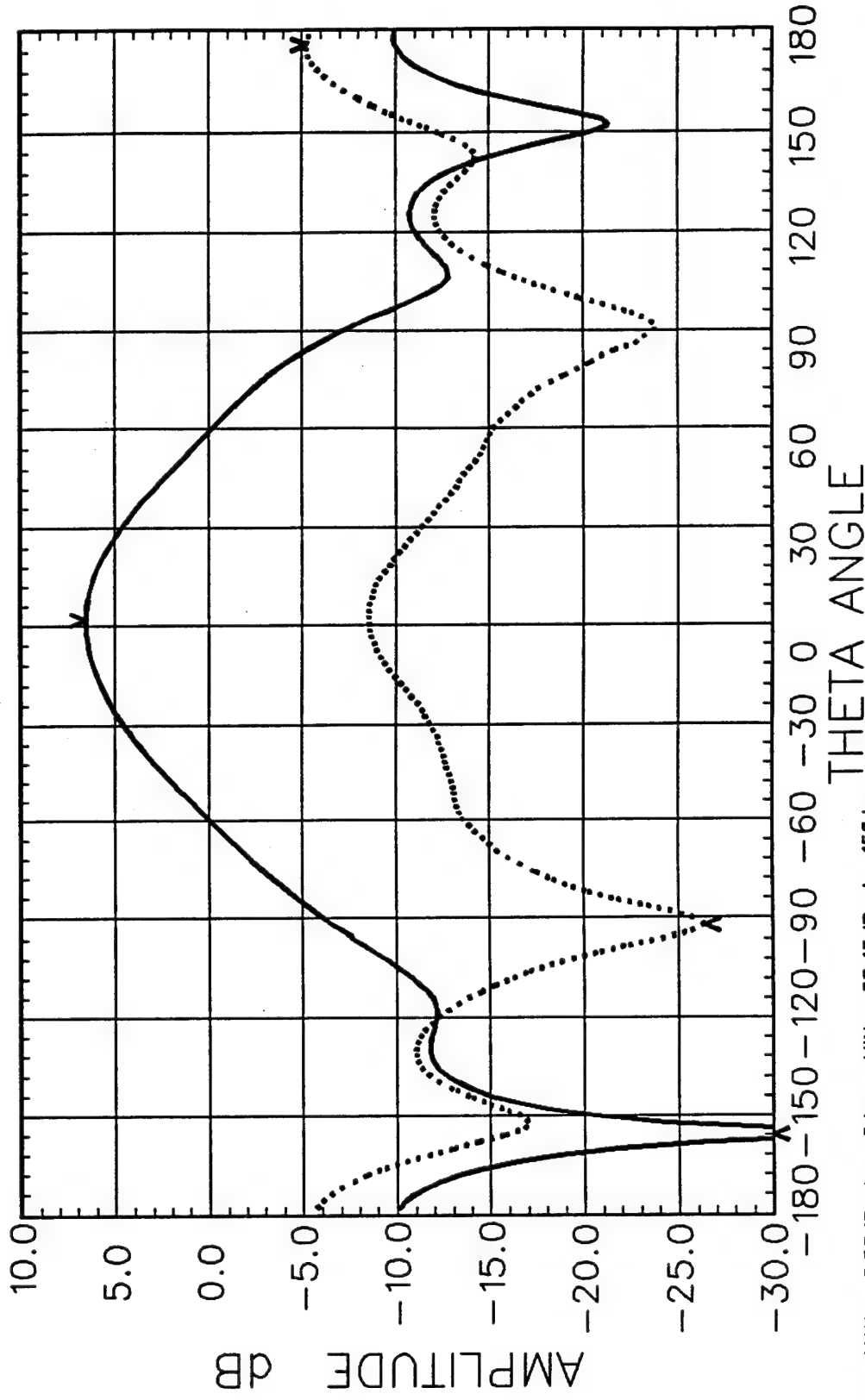
TAGGANT

BALL AEROSPACE

18 NOV 92

is 320MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 320MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE

CP6343 HAS 15dB IF ATTEN
CP6343 HAS 15dB IF ATTEN



MAX: 6.55dB at 2deg MIN: -37.18dB at -156deg
MAX: -5.24dB at 176deg MIN: -26.42dB at -92deg

2) RETURN MAY 92
CP6343 MAY 92
CP6343 MAY 92
CP6343 MAY 92

1/8"BELOW GP.5"BORDER
18 NOV 92

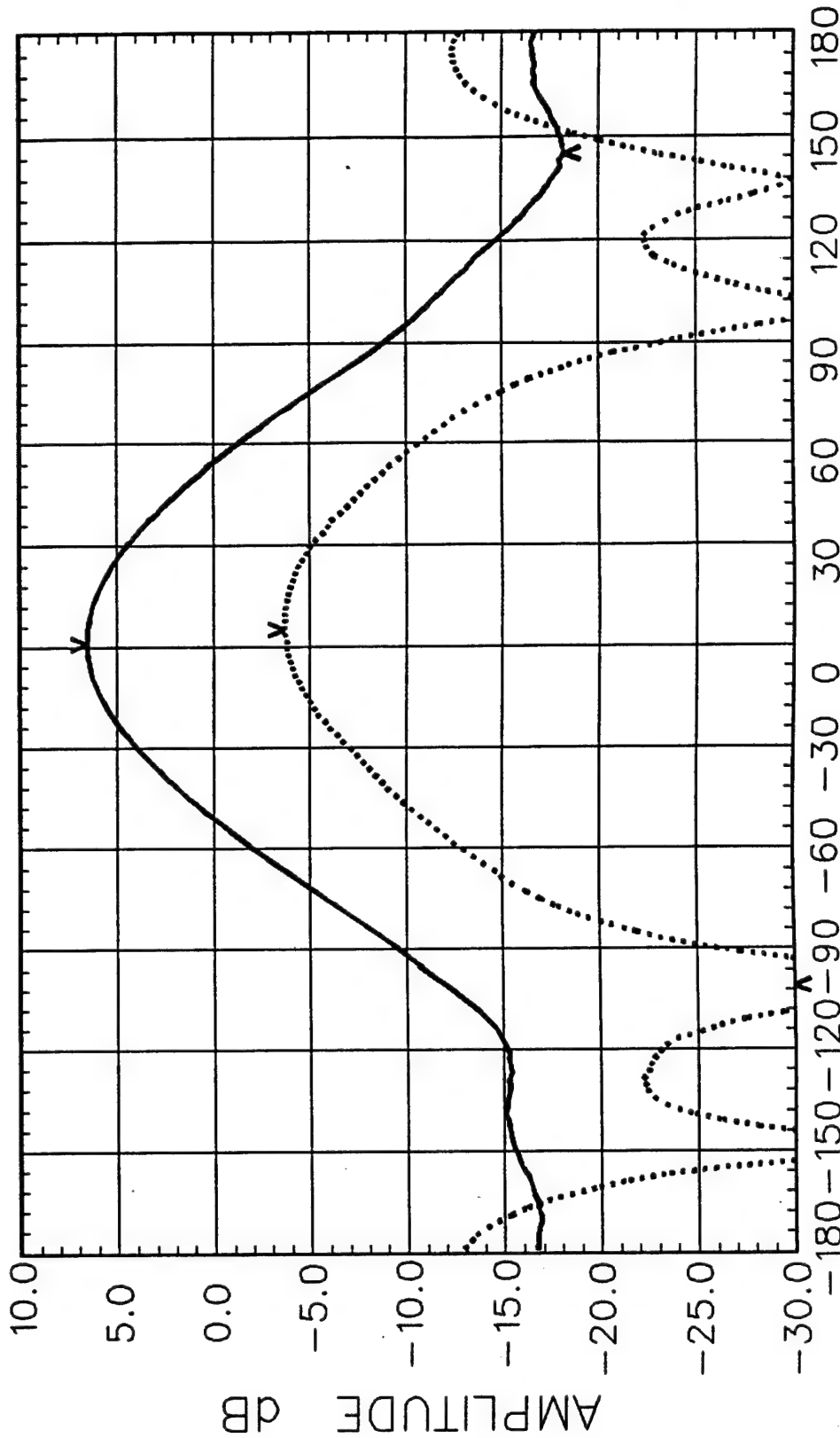
TAGGANT

BALL AEROSPACE

CP6361 HAS 15dB IF ATTN
CP6361 HAS 15dB IF ATTN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

260MHz RHCP GAIN PHI=
260MHz LHCP GAIN PHI=



MAX: 6.55dB at 0deg MIN: -18.24dB at 145deg
MAX: -3.67dB at 0deg MIN: -54.80dB at -101deg

3) RFLD:19 MAY 92 QTY:174-28 OCT 91
2) RFLD:19 MAY 92 QTY:174-28 OCT 91

1/8"BELOW GP.5"BORDER
18 NOV 92

TAGGANT

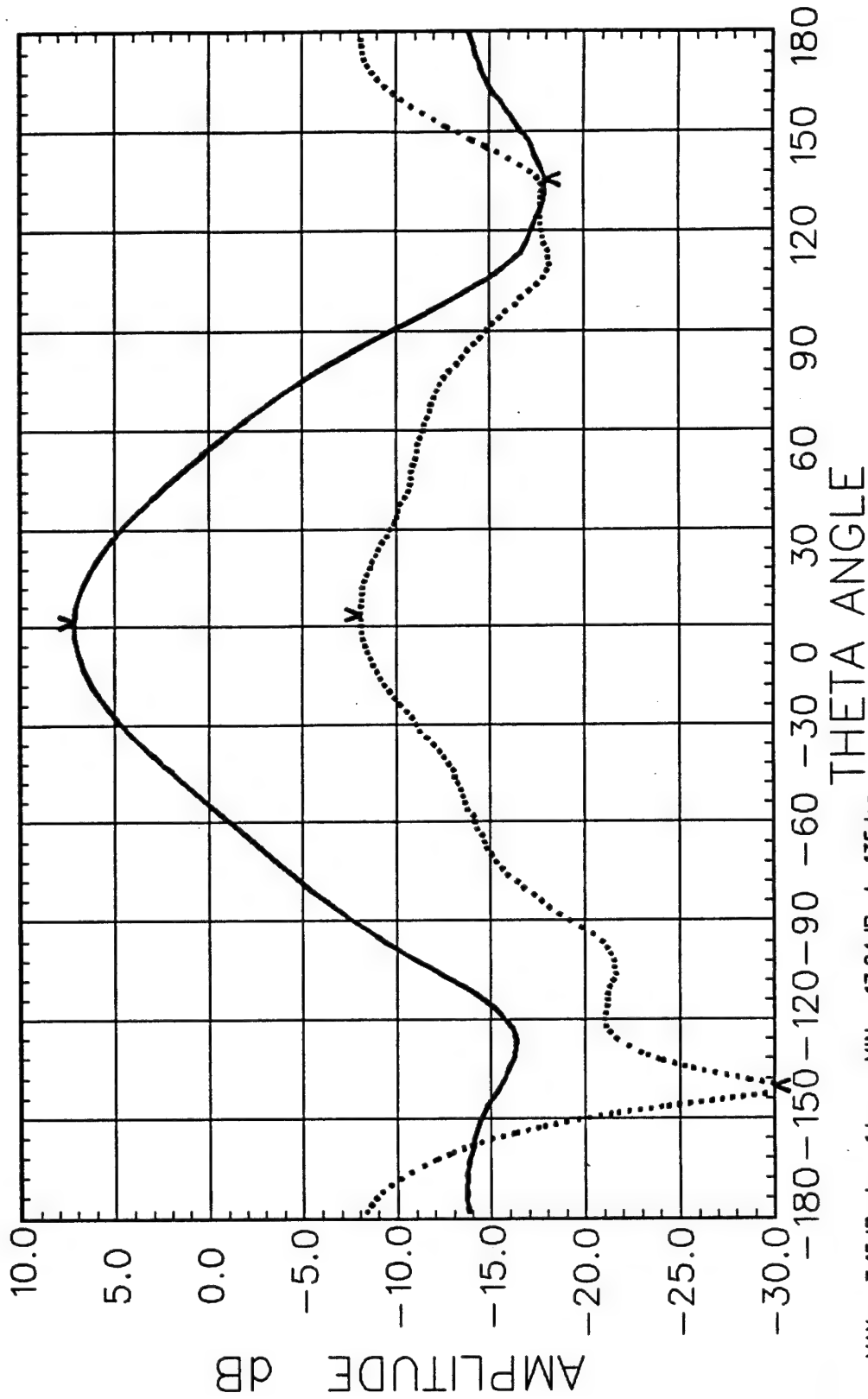
BALL AEROSPACE

CP6362 HAS 15dB IF ATTEN
CP6362 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

290MHz RHCP GAIN PHI=
290MHz LHCP GAIN PHI=

is
is



MAX: 7.15dB at 1deg MIN: -17.94dB at 135deg
MAX: -8.09dB at 3deg MIN: -30.60dB at -141deg

1) RPLDT:19 MAY 92
2) RPLDT:19 MAY 92
CP6362:28 OCT 91
CP6362:28 OCT 91

1/8"BELOW GP.5"BORDER
18 NOV 92

TAGGANT

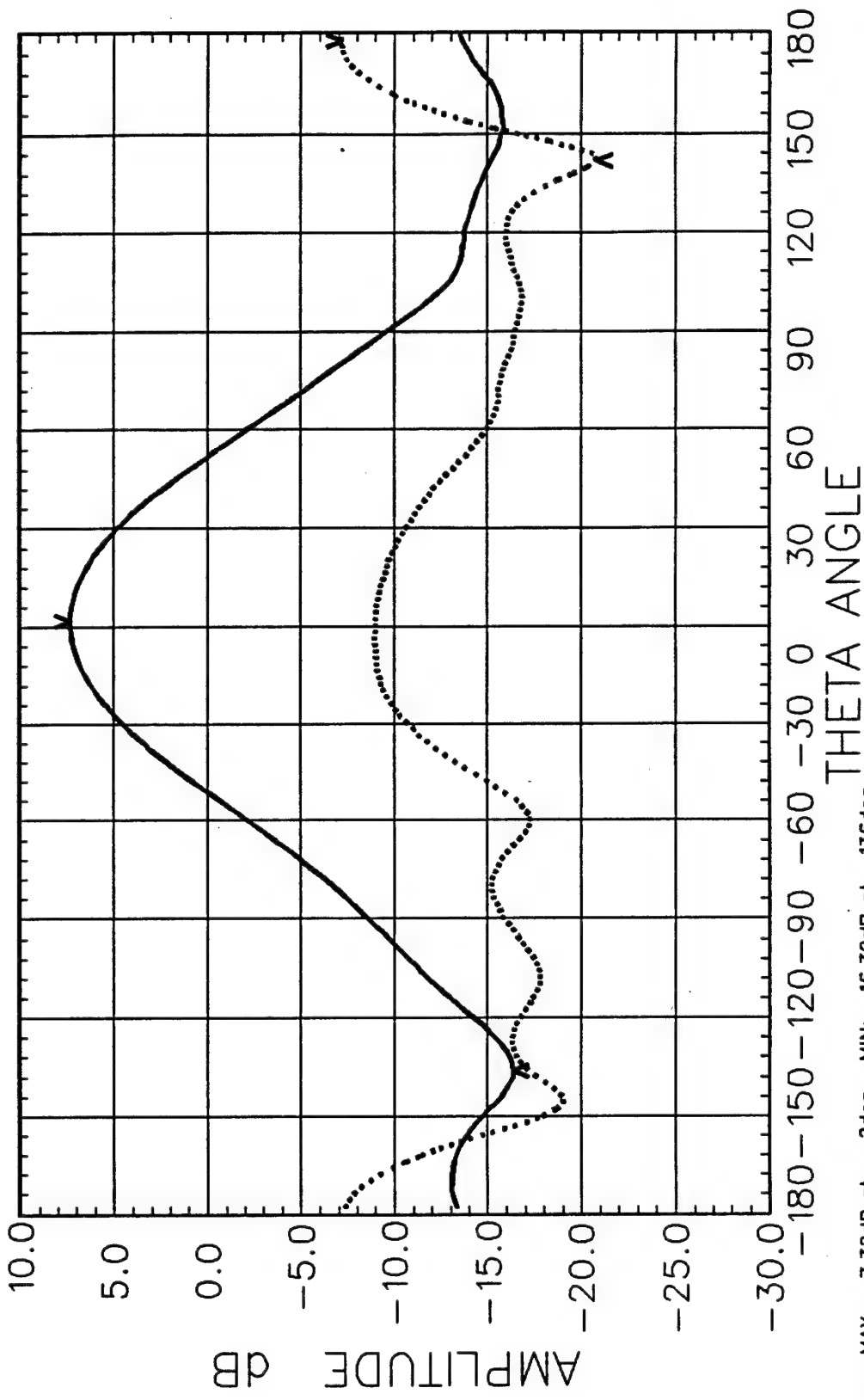
BALL AEROSPACE

CP6363 HAS 15dB IF ATTN
CP6363 HAS 15dB IF ATTN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

320MHz RHCP GAIN PHI=
320MHz LHCP GAIN PHI=

is
is



MAX: 7.32dB at 2deg MIN: -16.39dB at -136deg
MAX: -7.18dB at 178deg MIN: -20.84dB at 142deg

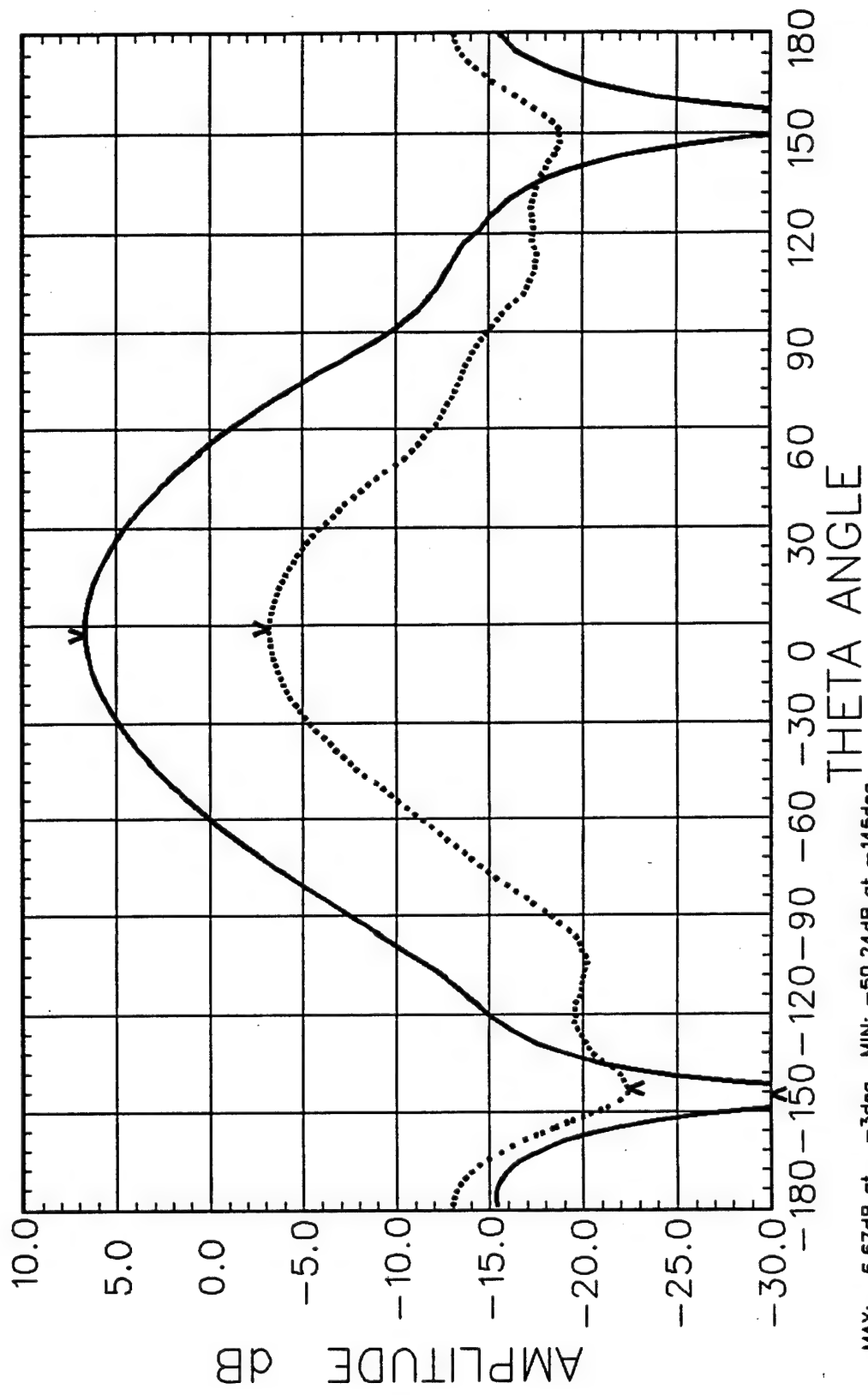
1/8" BELOW GP, 5" BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6381 HAS 15dB IF ATTEN
CP6381 HAS 15dB IF ATTEN

— is 260MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 260MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



— MAX: 6.67dB at -3deg MIN: -50.24dB at -145deg
..... MAX: -3.19dB at -1deg MIN: -22.42dB at -143deg

2) RETURN: 19 MAY 92 CP6381: 28 OCT 91
1) RETURN: 19 MAY 92 CP6381: 28 OCT 91

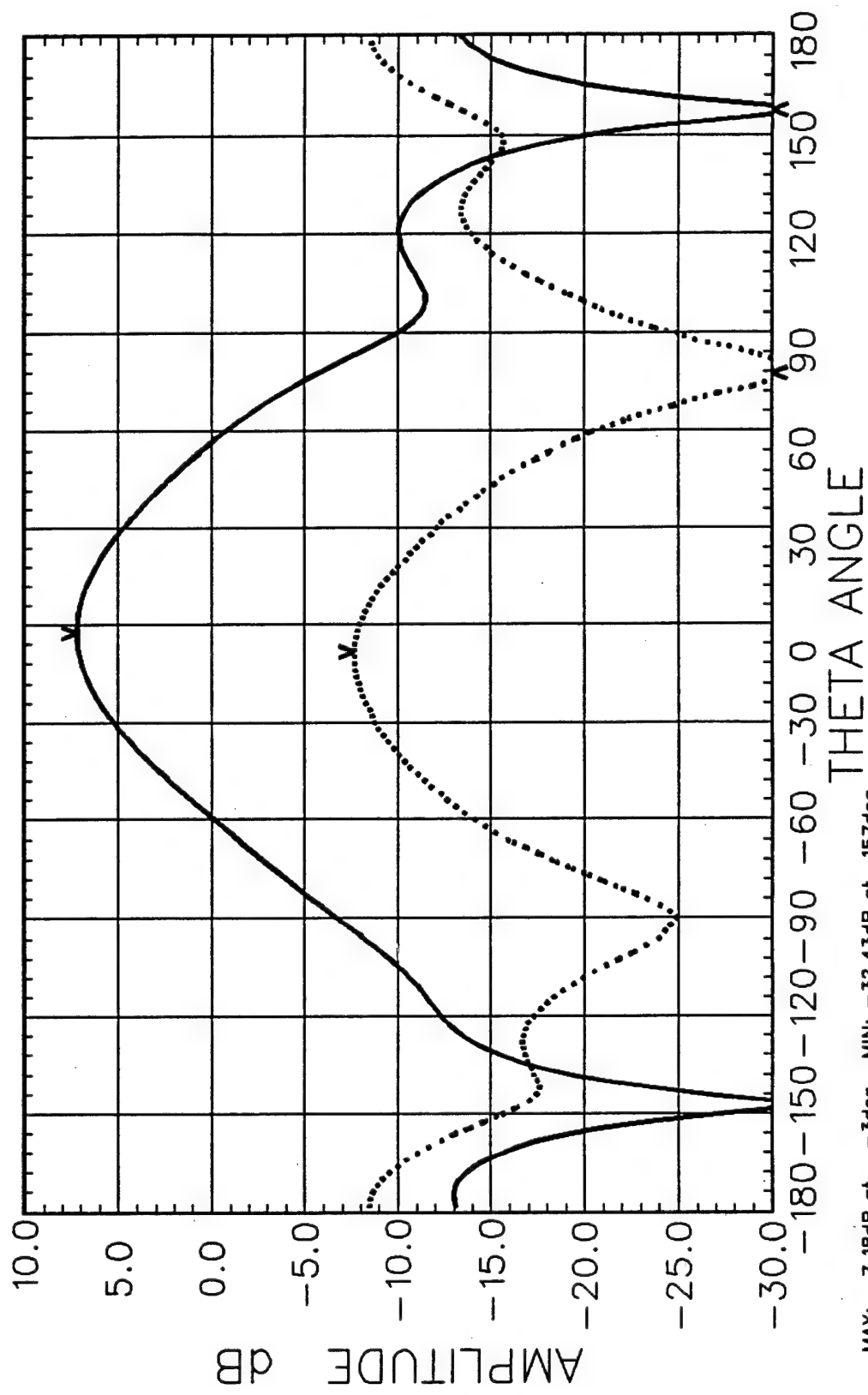
1/8"BELOW GP.5"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6382 HAS 15dB IF ATTEN
CP6382 HAS 15dB IF ATTEN

— is 290MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 290MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



— MAX: 7.18dB at -3deg MIN: -32.43dB at 157deg
..... MAX: -7.67dB at -9deg MIN: -31.06dB at 77deg

1. RPL01:19 MAY 92
2. RPL01:19 MAY 92
CP6382:28 OCT 91
CP6382:28 OCT 91

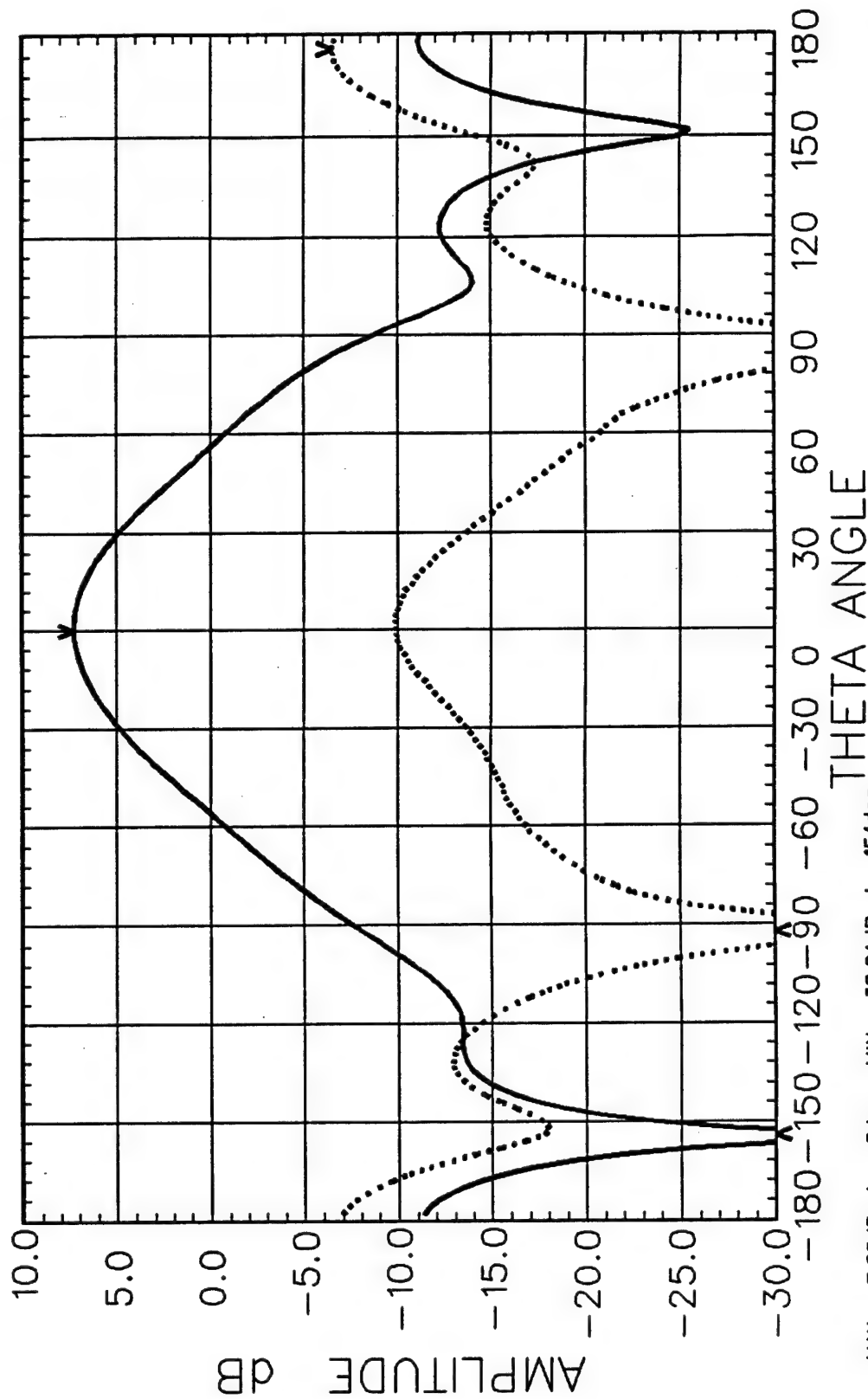
1/8"BELOW GP,5"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6383 HAS 15dB IF ATTEN
CP6383 HAS 15dB IF ATTEN

320MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
320MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



— MAX: 7.26dB at 0deg MIN: -38.24dB at -154deg
..... MAX: -6.49dB at 176deg MIN: -52.74dB at -92deg

1) PLOT: 19 MAY 92
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1/2"BELOW GP,1"BORDER
18 NOV 92

TAGGANT

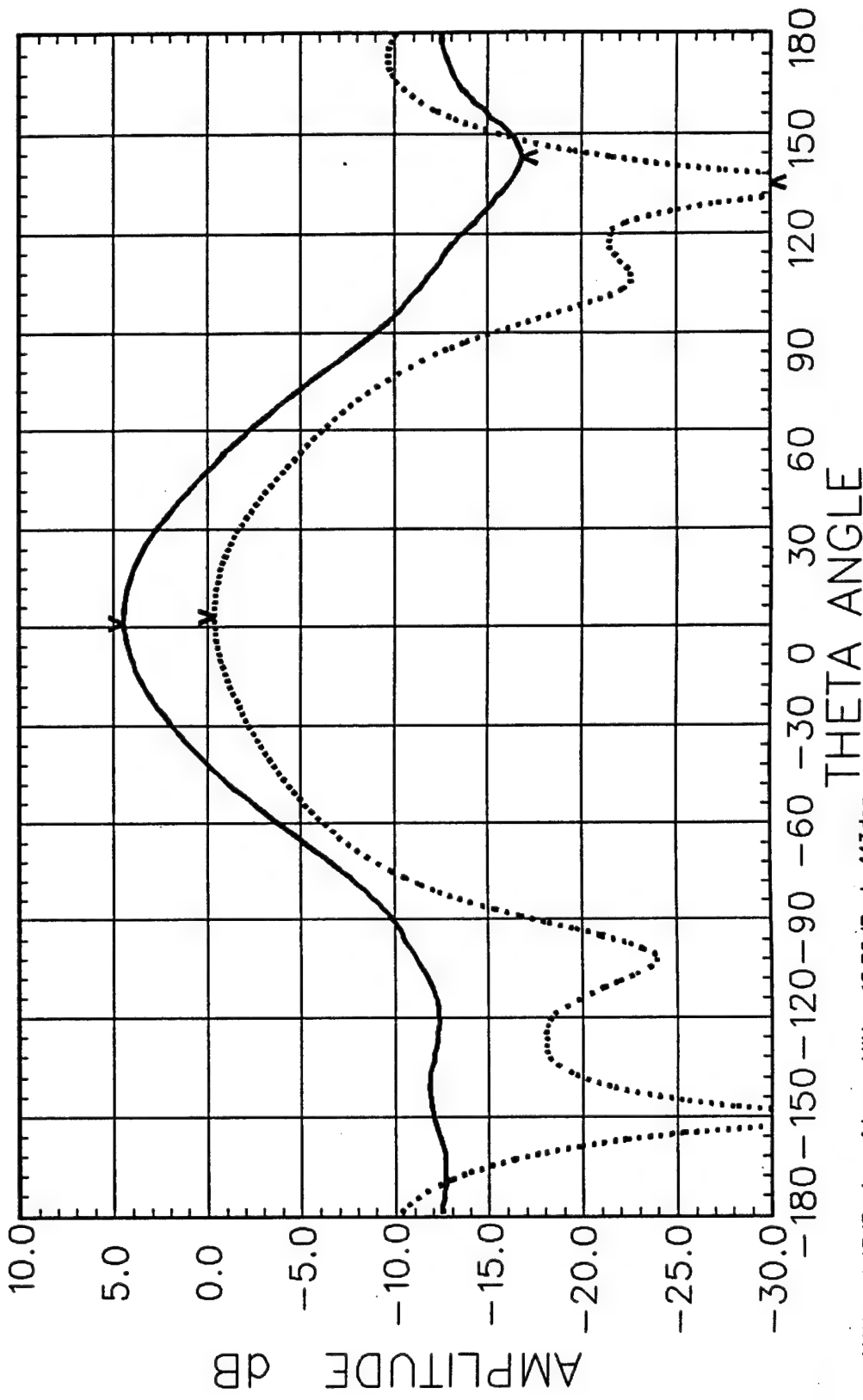
BALL AEROSPACE

CP6401 HAS 15dB IF ATTEN
CP6401 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

260MHz RHCP GAIN PHI=
260MHz LHCP GAIN PHI=

is
is



MAX: 4.45dB at 1deg MIN: -16.82dB at 143deg
MAX: -37dB at 3deg MIN: -39.96dB at 135deg

1/2"BELOW GP,1"BORDER
18 NOV 92

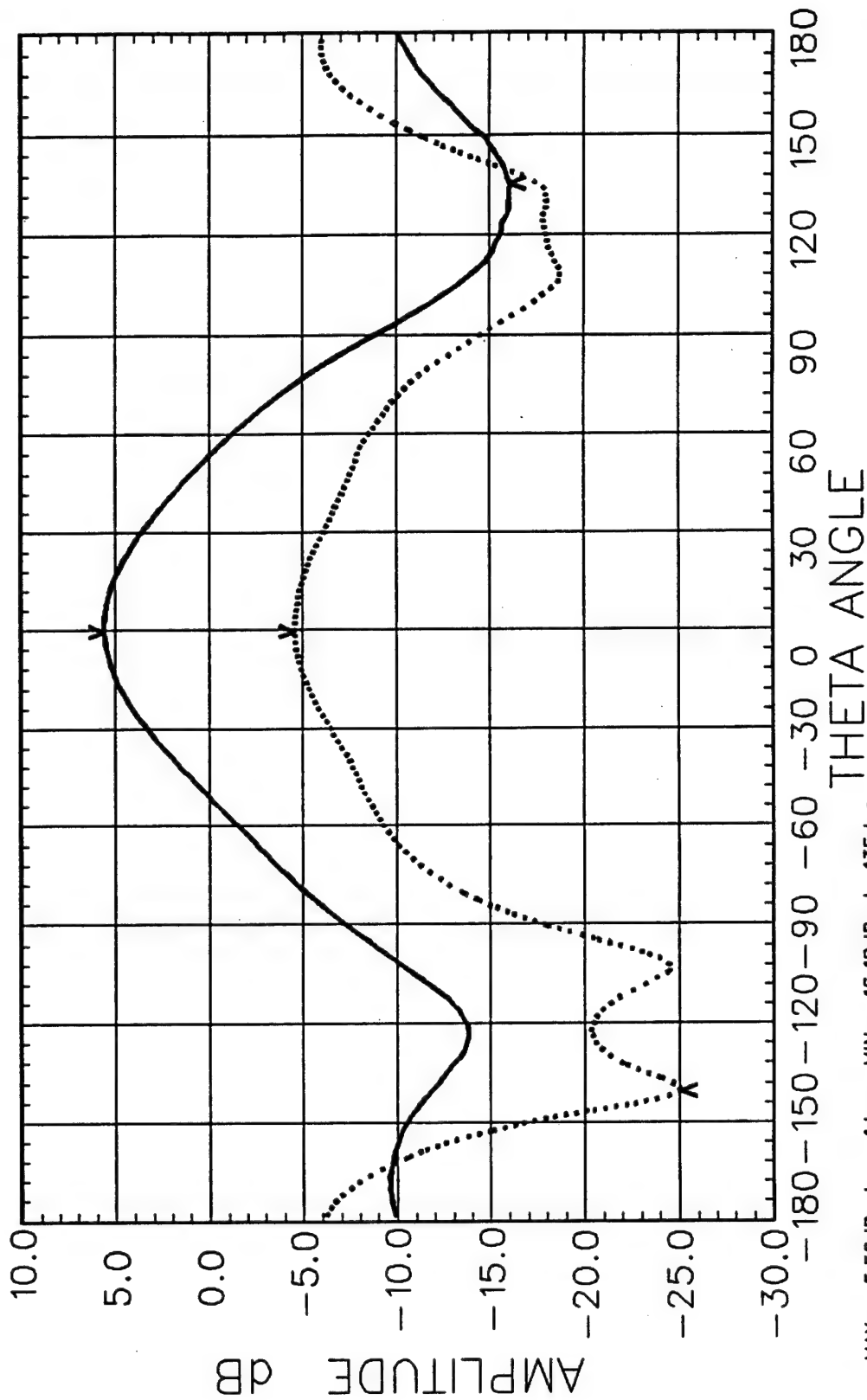
TAGGANT

BALL AEROSPACE

CP6402 HAS 15dB IF ATTEN
CP6402 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

is 290MHz RHCP GAIN PHI=
is 290MHz LHCP GAIN PHI=



MAX: 5.59dB at -1deg MIN: -16.10dB at 135deg
MAX: -4.56dB at -1deg MIN: -25.14dB at -141deg

1) REPORT: 18 MAY 92
2) REPORT: 18 MAY 92
CP6402-28 OCT 91
CP6402-28 OCT 91

1/2"BELOW GP,1"BOARD
18 NOV 92

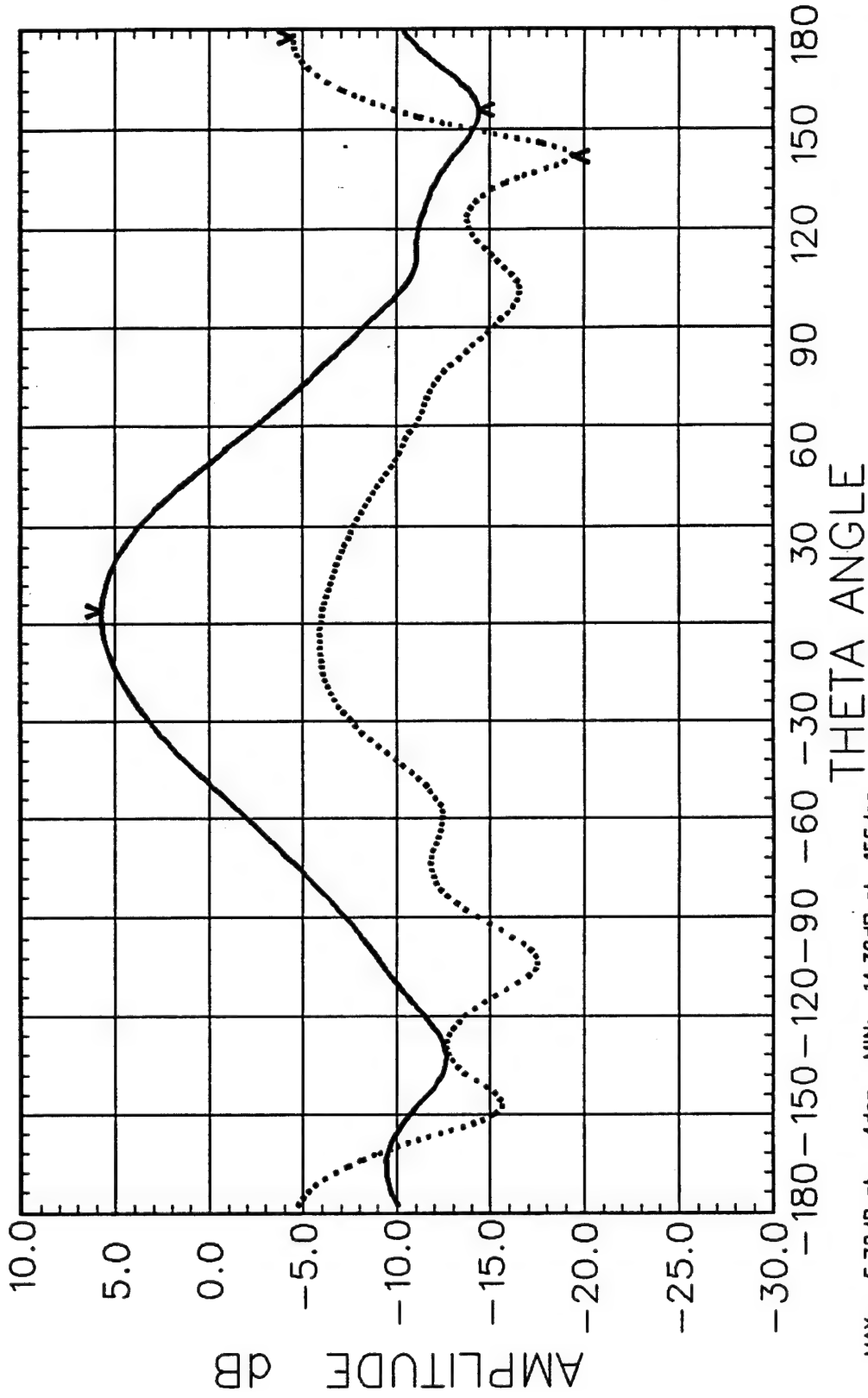
TAGGANT

BALL AEROSPACE

— is 320MHz RHCP GAIN PHI=
..... is 320MHz LHCP GAIN PHI=

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

CP6403 HAS 15dB IF ATTEN
CP6403 HAS 15dB IF ATTEN



— MAX: 5.72dB at 4deg MIN: -14.39dB at 156deg
..... MAX: -4.48dB at 178deg MIN: -19.47dB at 142deg

22 REF: 19 MAY 92
CPX: 28 OCT 91
CPX: 28 OCT 91

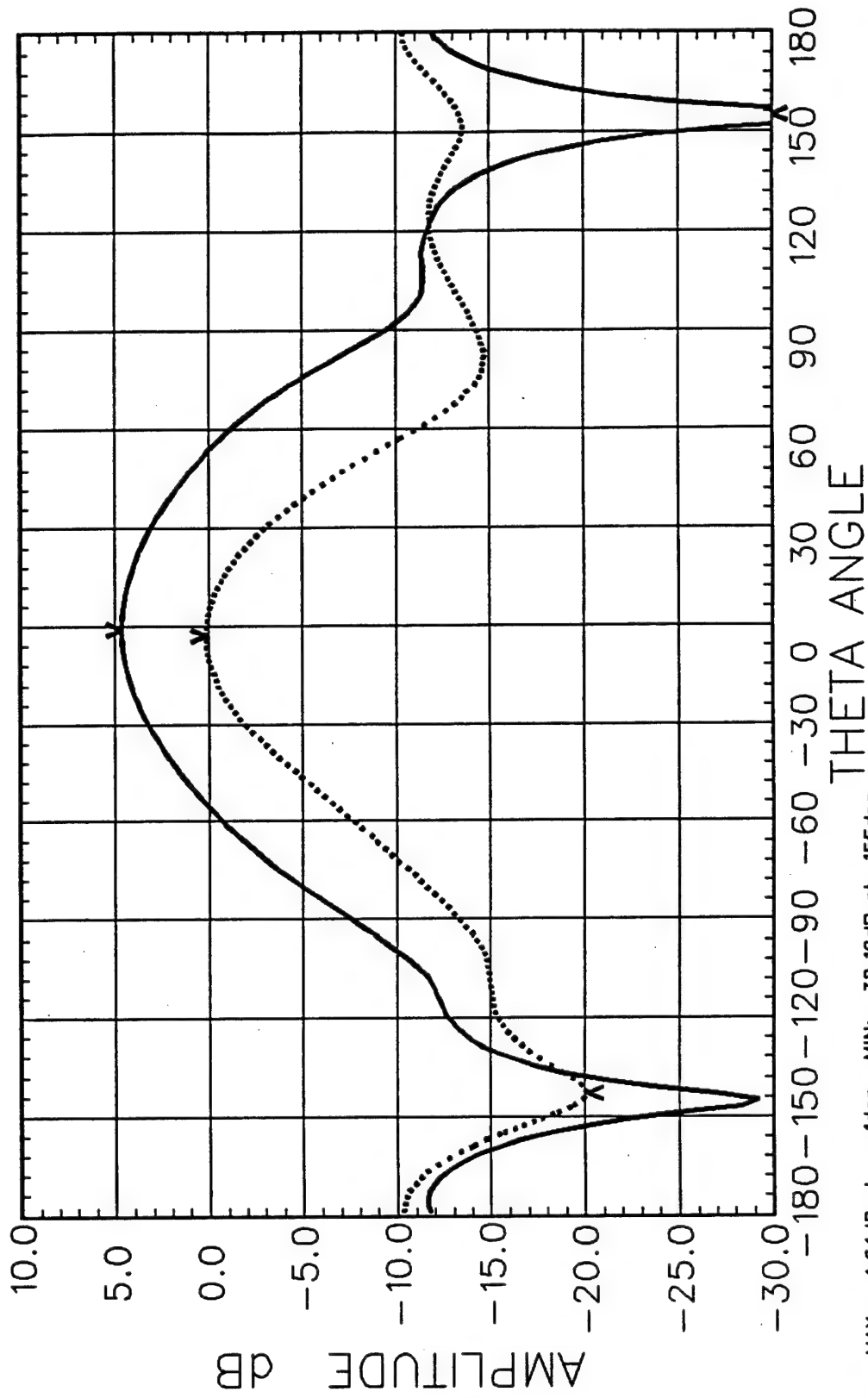
1/2"BELOW GP,1"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6421 HAS 15dB IF ATTEN
CP6421 HAS 15dB IF ATTEN

— is 260MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 260MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



— MAX: 4.64dB at -1deg MIN: -38.19dB at 155deg
..... MAX: .12dB at -3deg MIN: -20.17dB at -143deg

2) RPLUT:19 MAY 92
CP6421:28 OCT 91
CP6421:28 OCT 91

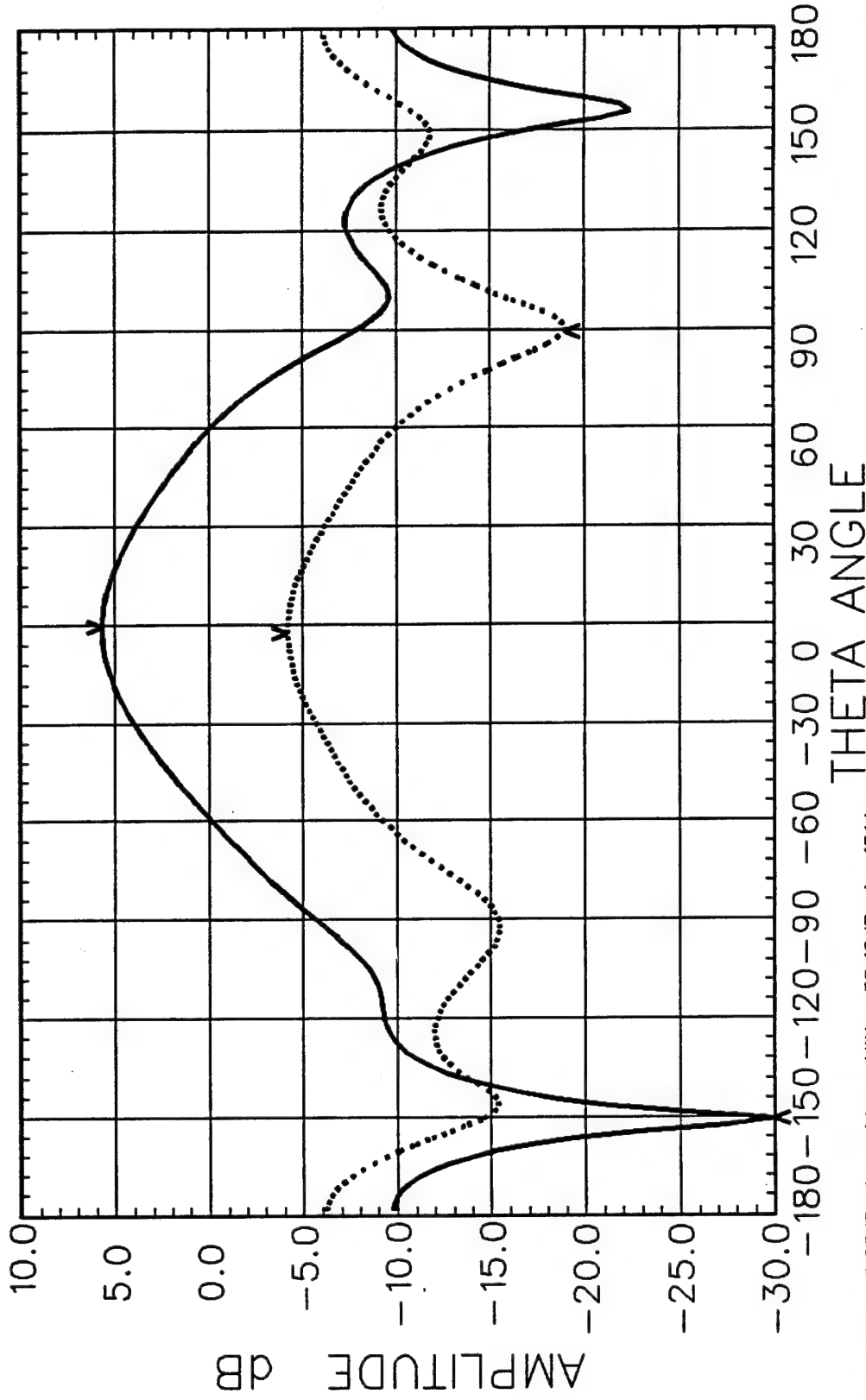
1/2"BELOW GP,1"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6422 HAS 15dB IF ATTEN
CP6422 HAS 15dB IF ATTEN

290MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
290MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



— MAX: 5.67dB at -1deg MIN: -30.19dB at -151deg
..... MAX: -4.19dB at -3deg MIN: -18.98dB at 89deg

2) REF: 18 MAY 92
CP6422 28 OCT 91 11

1/2"BELOW GP, 1"BORDER

18 NOV 92

1. 1 1

320MHZ RHCP GAIN PHI=
320MHZ LHCP GAIN PHI=

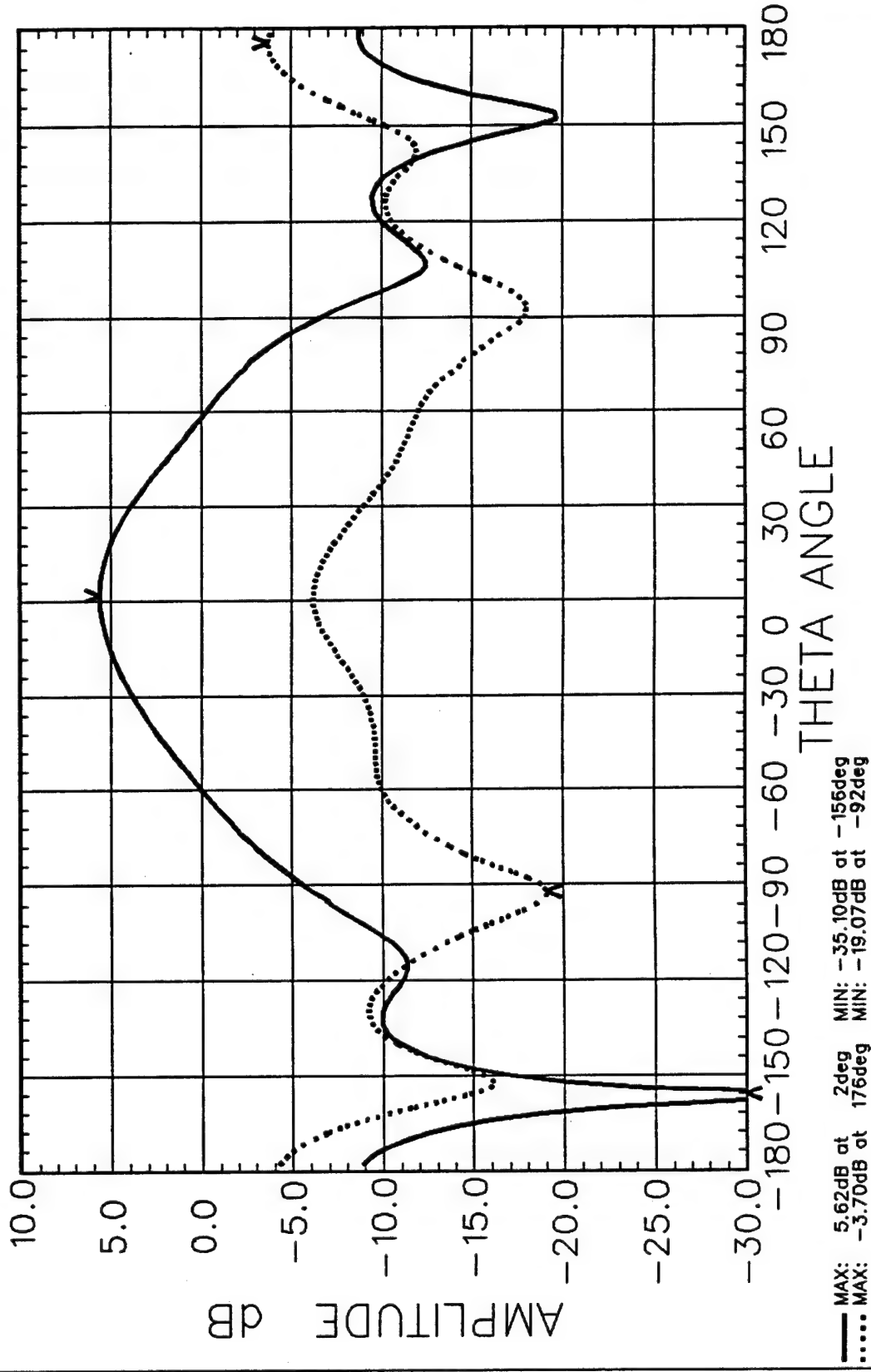
90deg ABSOLUTE AMPLITUDE
90deg ABSOLUTE AMPLITUDE

CP6423 HAS 15dB IF ATTEN
CP6423 HAS 15dB IF ATTEN

CP6423 HAS 15dB IF ATTEN
CP6423 HAS 15dB IF ATTEN

BALL AEROSPACE

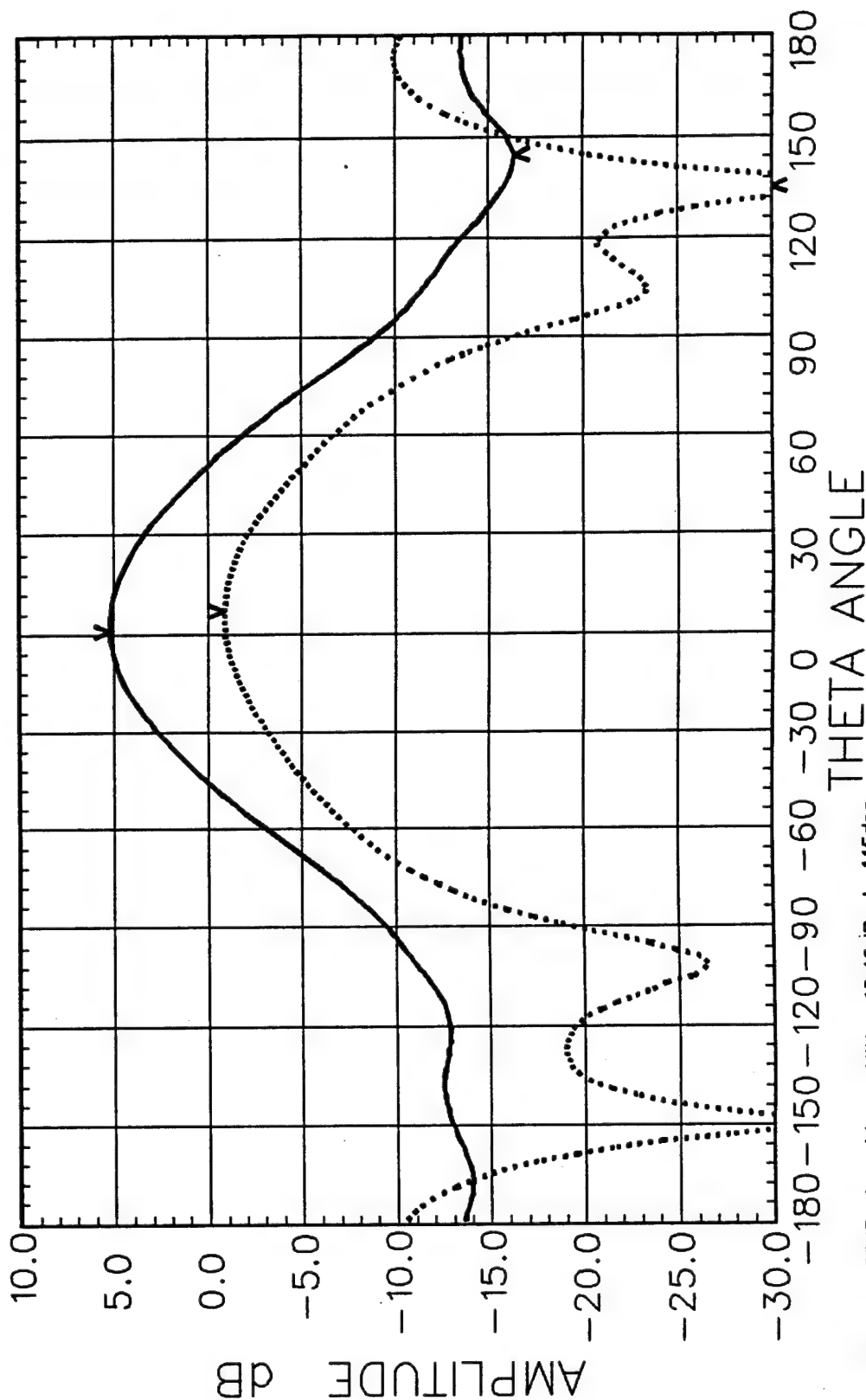
TAGGANT



CP6441 HAS 15dB IF ATTEN
CP6441 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

260MHz RHCP GAIN PHI=
260MHz LHCP GAIN PHI=



MAX: 5.22dB at 1deg MIN: -16.40dB at 145deg
MAX: -88dB at 7deg MIN: -39.08dB at 135deg

1/2"BELOW GP,2"BORDER
18 NOV 92

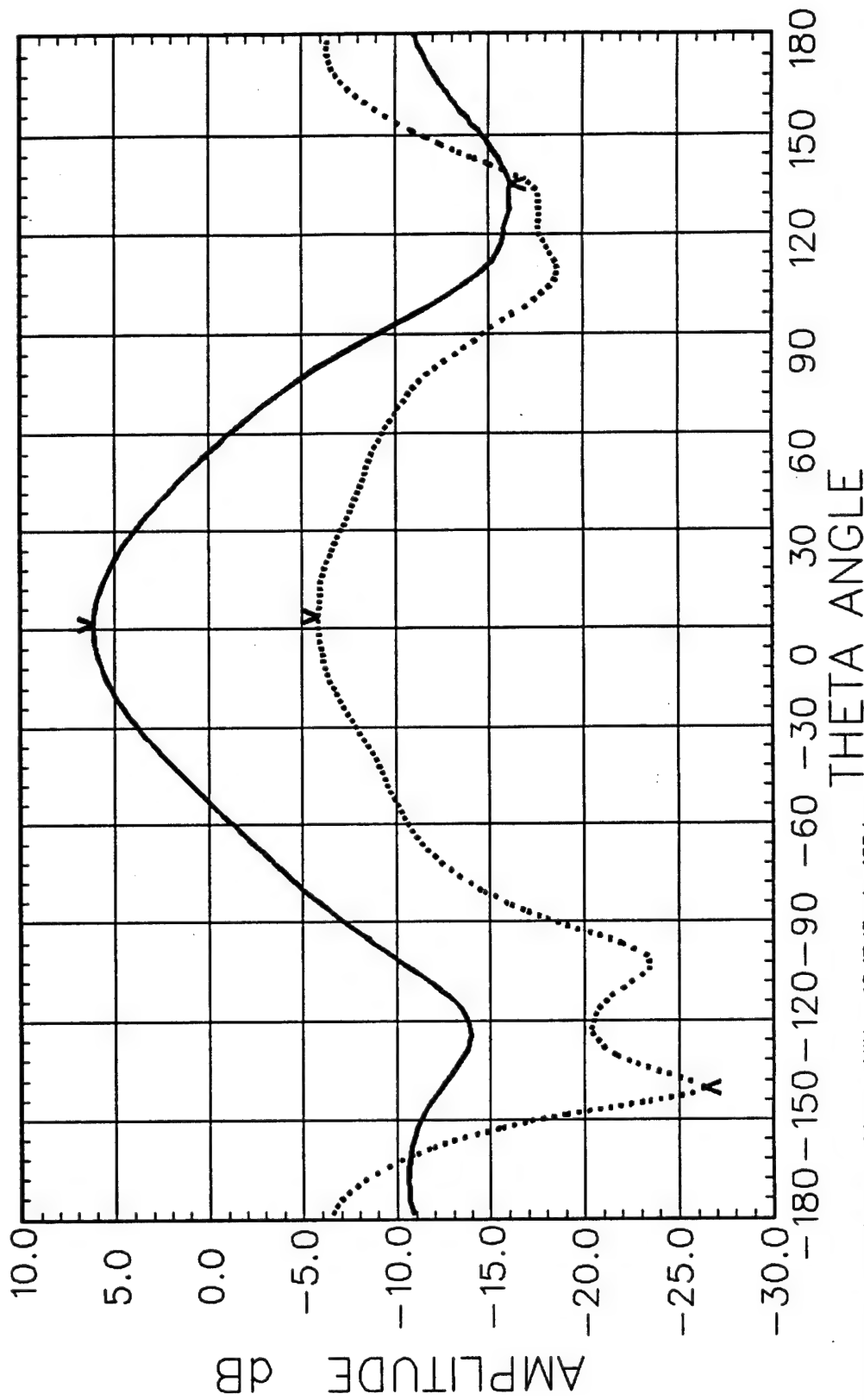
TAGGANT

BALL AEROSPACE

CP6442 HAS 15dB IF ATTEN
CP6442 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

is 290MHz RHCP GAIN PHI=
is 290MHz LHCP GAIN PHI=



MAX: 6.12dB at 1deg MIN: -16.17dB at 135deg
MAX: -5.85dB at 3deg MIN: -26.39dB at -141deg

18 NOV 92
CP6442 HAS 15dB IF ATTEN
CP6442 HAS 15dB IF ATTEN

1/2"BELOW GP,2"BORDER
18 NOV 92

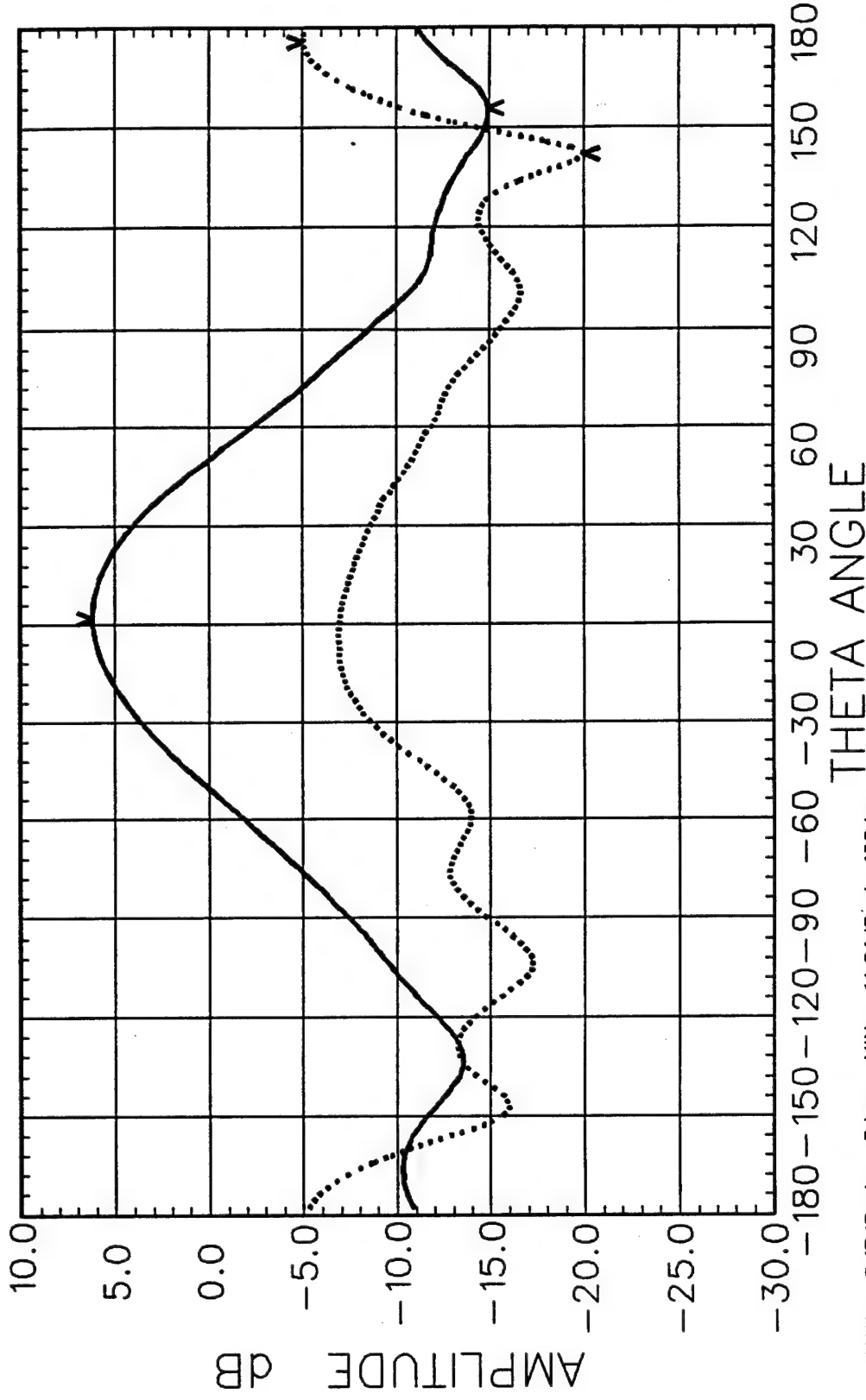
TAGGANT

BALL AEROSPACE

CP6443 HAS 15dB IF ATTEN
CP6443 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

320MHz RHCP GAIN PHI=
320MHz LHCP GAIN PHI=



MAX: 6.17dB at 2deg MIN: -14.91dB at 156deg
MAX: -5.04dB at 176deg MIN: -20.03dB at 142deg

2) REF: 18 MAY 92 CP: 18 MAY 92
1) REF: 18 MAY 92 CP: 18 MAY 92

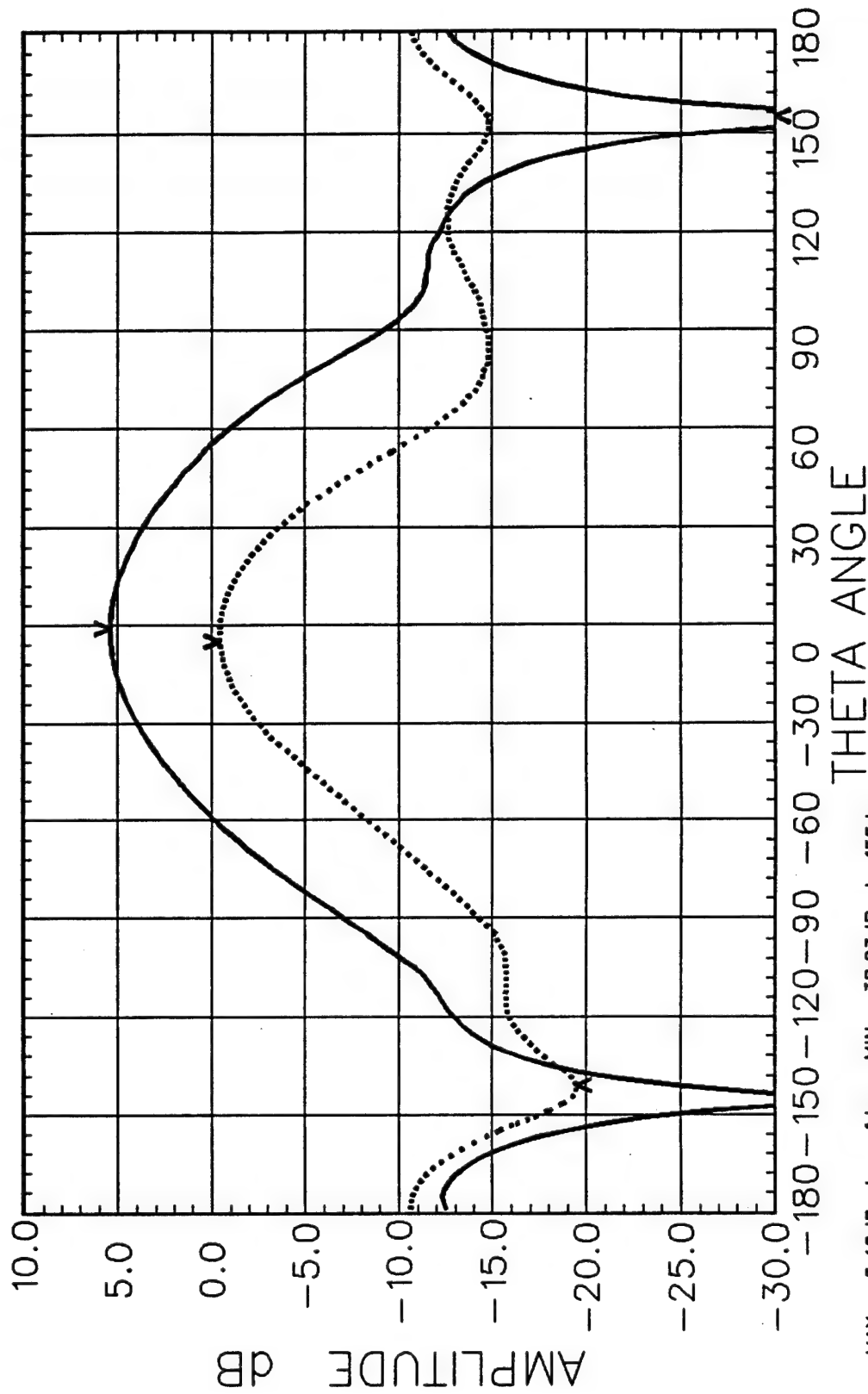
1/2"BELOW GP,2"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6461 HAS 15dB IF ATTEN
CP6461 HAS 15dB IF ATTEN

260MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
260MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



MAX: 5.40dB at -1deg MIN: -38.93dB at 155deg
MAX: -45dB at -5deg MIN: -19.49dB at -141deg

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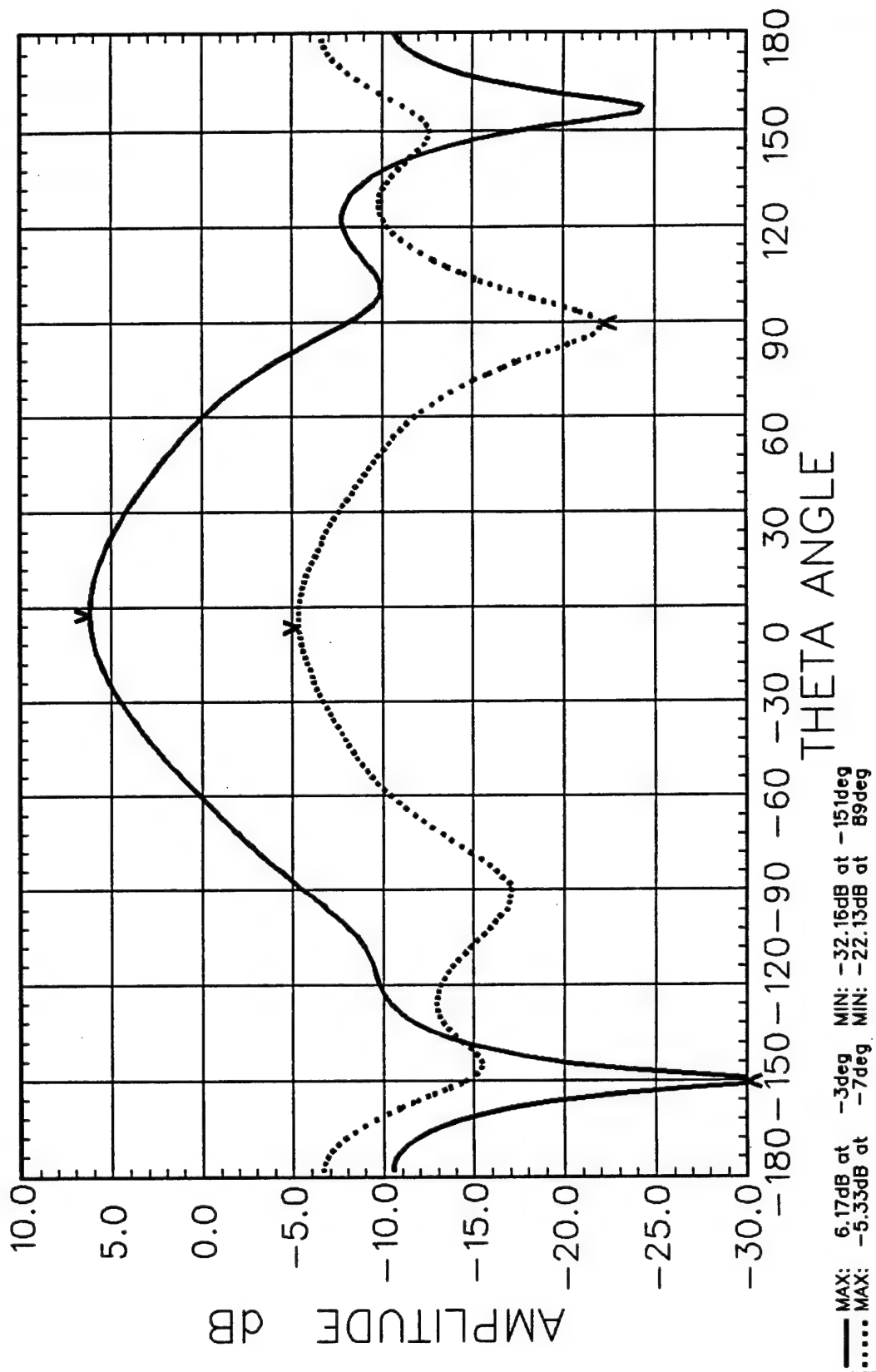
1/2"BELOW GP,2"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6462 HAS 15dB IF ATTEN
CP6462 HAS 15dB IF ATTEN

— is 290MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 290MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



2) RPLUT:19 MAY 92
CP6462:28 OCT 91

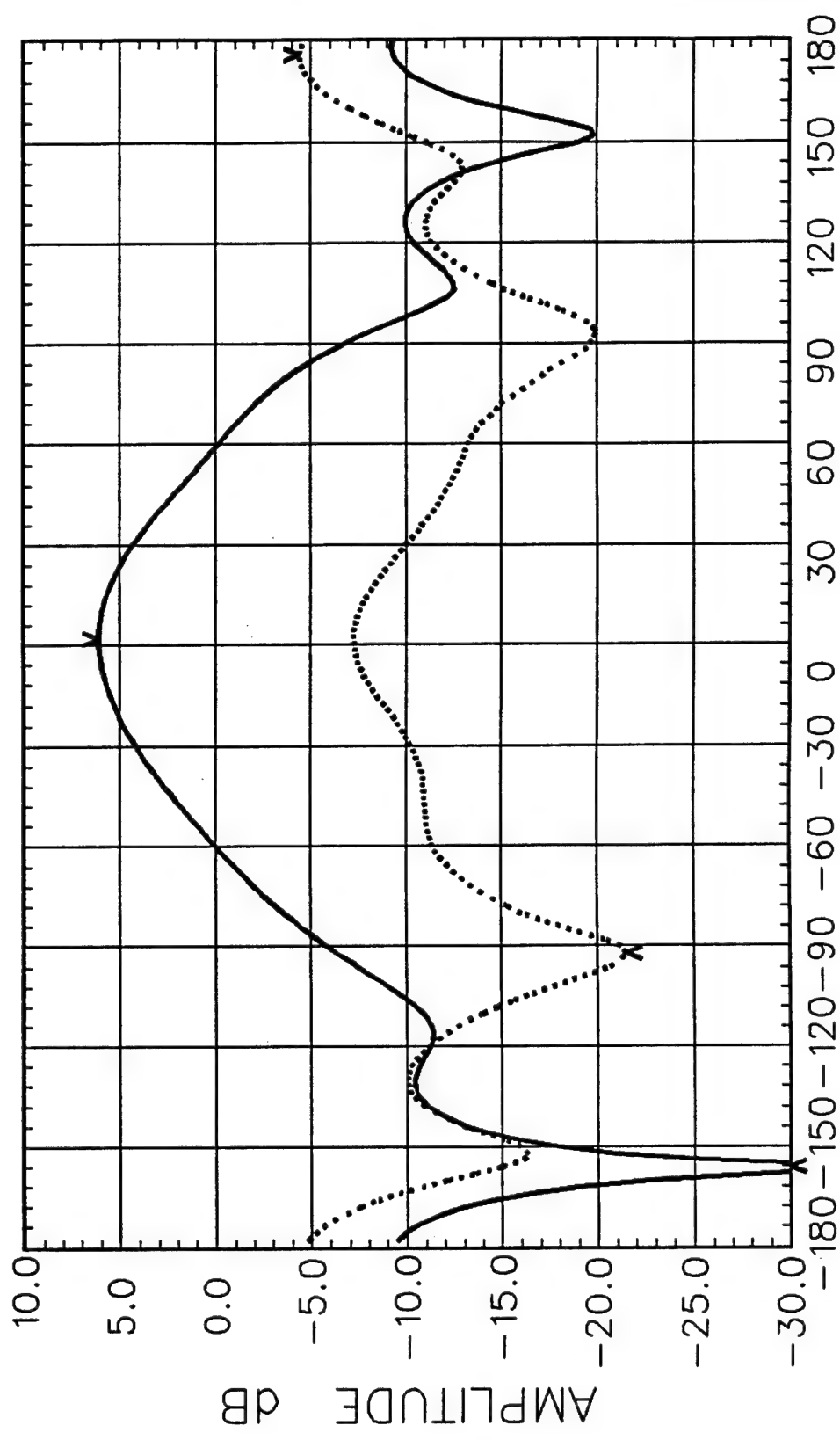
1/2"BELOW GP,2"BORDER
18 NOV 92

TAGGANT

18 NOV 92

CP6463 HAS 15dB IF ATTN
CP6463 HAS 15dB IF ATTN

is 320MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 320MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



THETA ANGLE

MAX: 6.09dB at 2deg MIN: -34.61dB at -156deg
MAX: -4.41dB at 176deg MIN: -21.51dB at -92deg

1) REFLECTOR MAY 92
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1/2"BELOW GP,3"BORDER
18 NOV 92

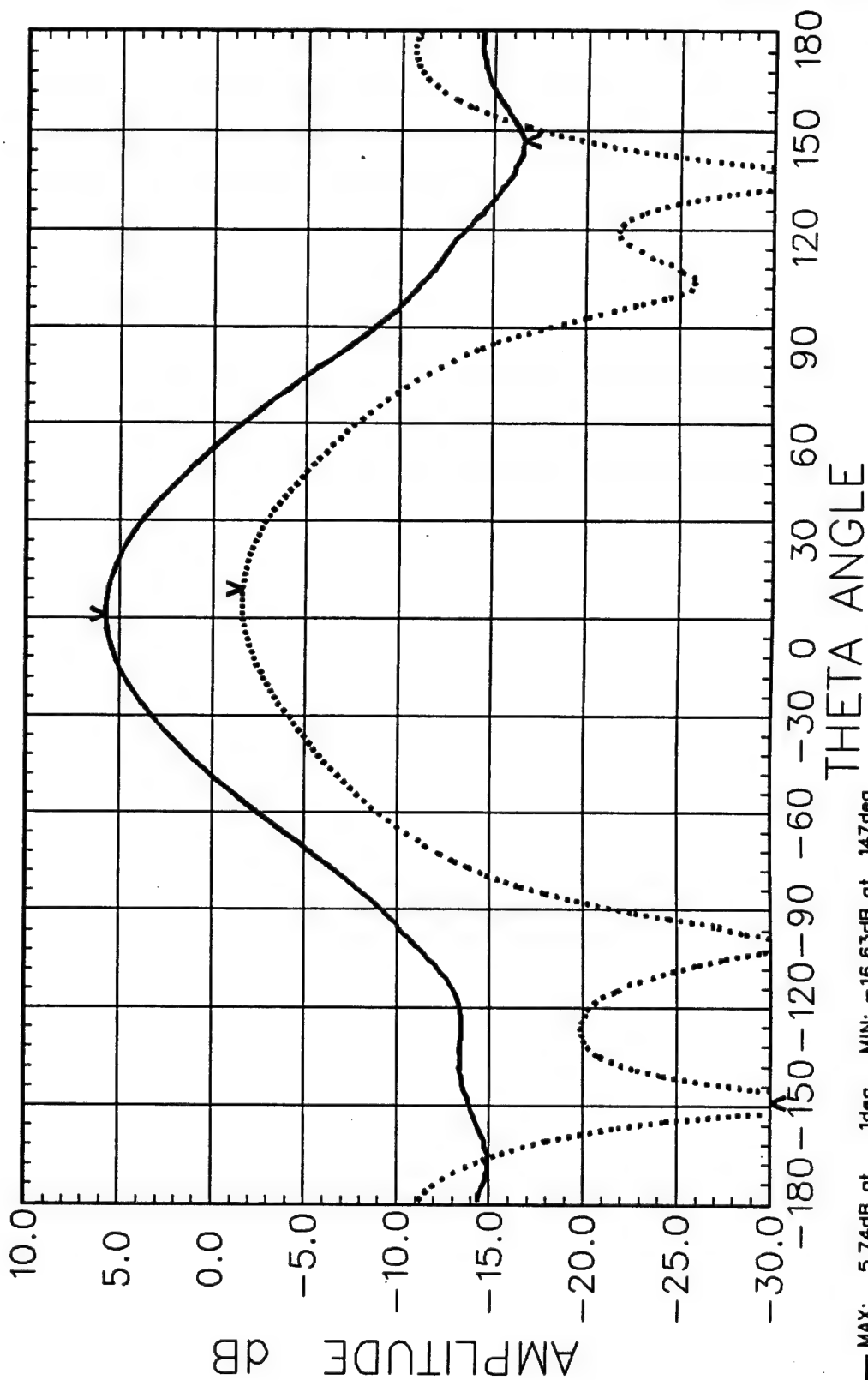
TAGGANT

BALL AEROSPACE

CP6481 HAS 15dB IF ATTEN
CP6481 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

260MHz RHCP GAIN PHI=
260MHz LHCP GAIN PHI=



MAX: 5.74dB at 1deg MIN: -16.63dB at 147deg
MAX: -1.57dB at 9deg MIN: -38.71dB at -149deg

1) RFLUT:19 MAY 92
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1/2"BELOW GP,3"BORDER
18 NOV 92

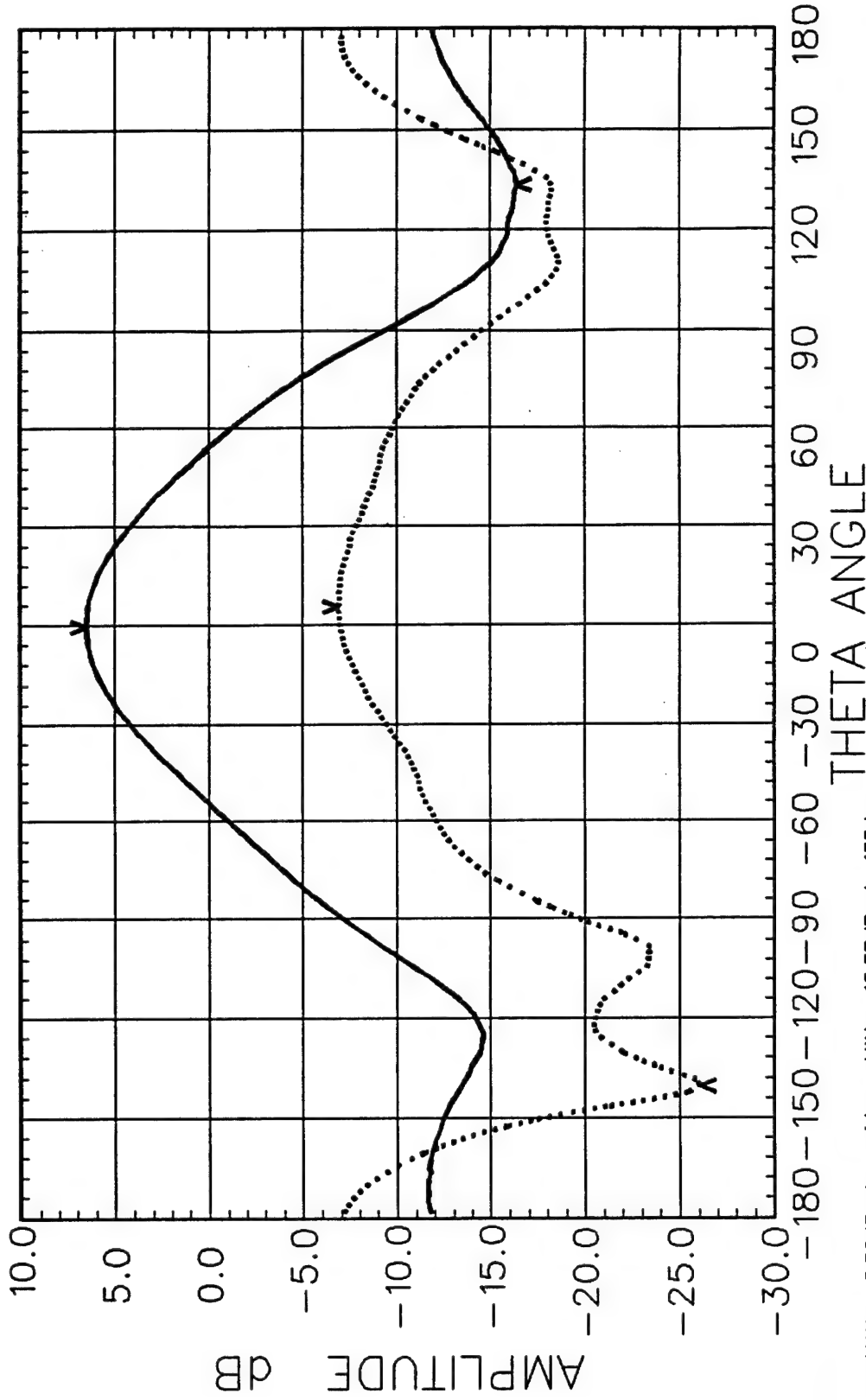
TAGGANT

BALL AEROSPACE

CP6482 HAS 15dB IF ATTEN
CP6482 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

is 290MHz RHCP GAIN PHI=
is 290MHz LHCP GAIN PHI=



MAX: 6.50dB at -1deg MIN: -16.37dB at 133deg
MAX: -6.89dB at 5deg MIN: -26.11dB at -141deg

2) REPT: 18 MAY 92
CP6482: 28 OCT 91
CP6482: 28 OCT 91

1/2"BELOW GP,3"BORDER
18 NOV 92

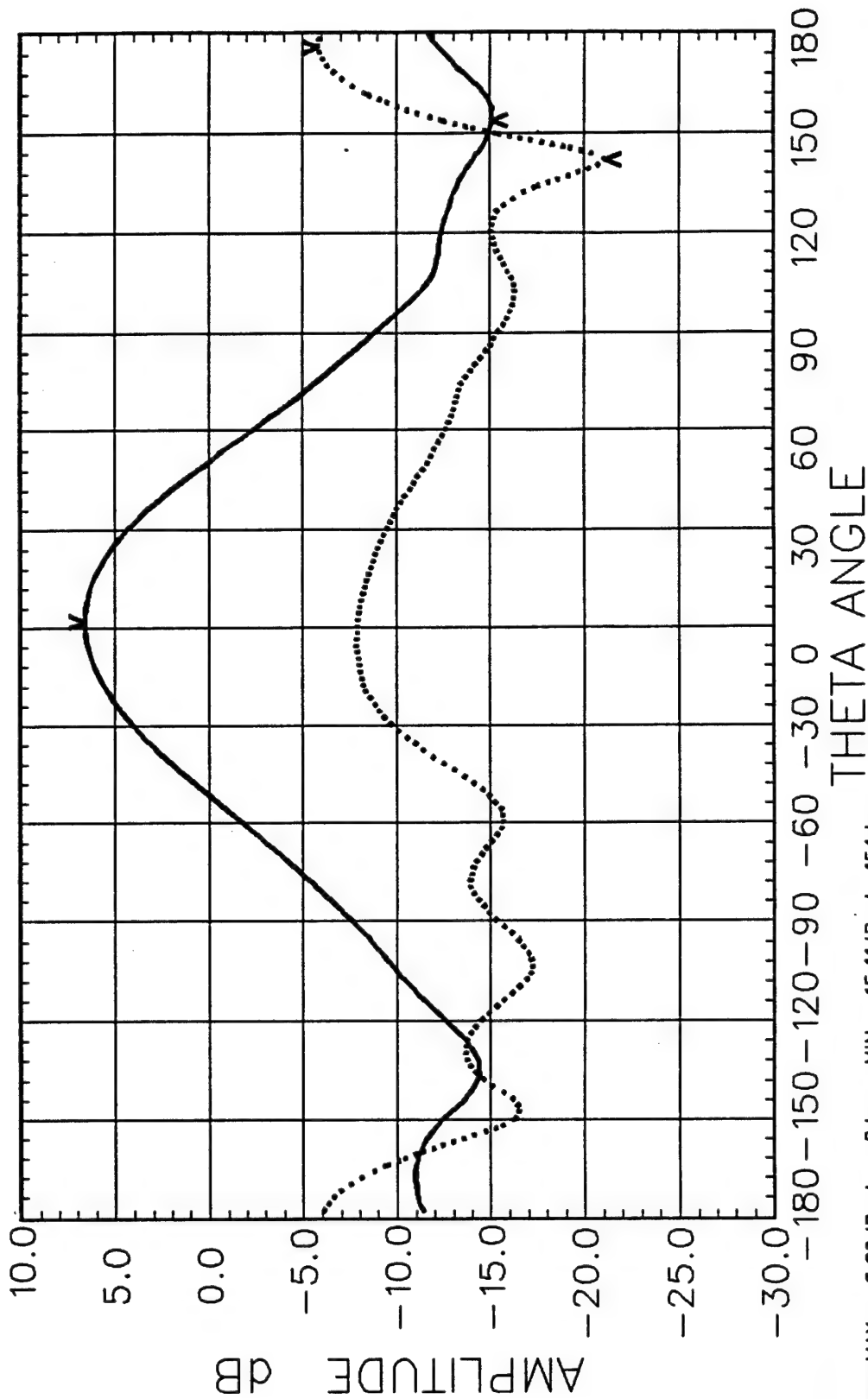
TAGGANT

BALL AEROSPACE

CP6483 HAS 15dB IF ATTEN
CP6483 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

is 320MHz RHCP GAIN PHI=
is 320MHz LHCP GAIN PHI=



MAX: 6.60dB at 2deg MIN: -15.11dB at 154deg
MAX: -5.82dB at 176deg MIN: -21.15dB at 142deg

1) RPLT:19 MAY 92
2) RPLT:28 OCT 91

1/2"BELOW GP,3"BORDER
18 NOV 92

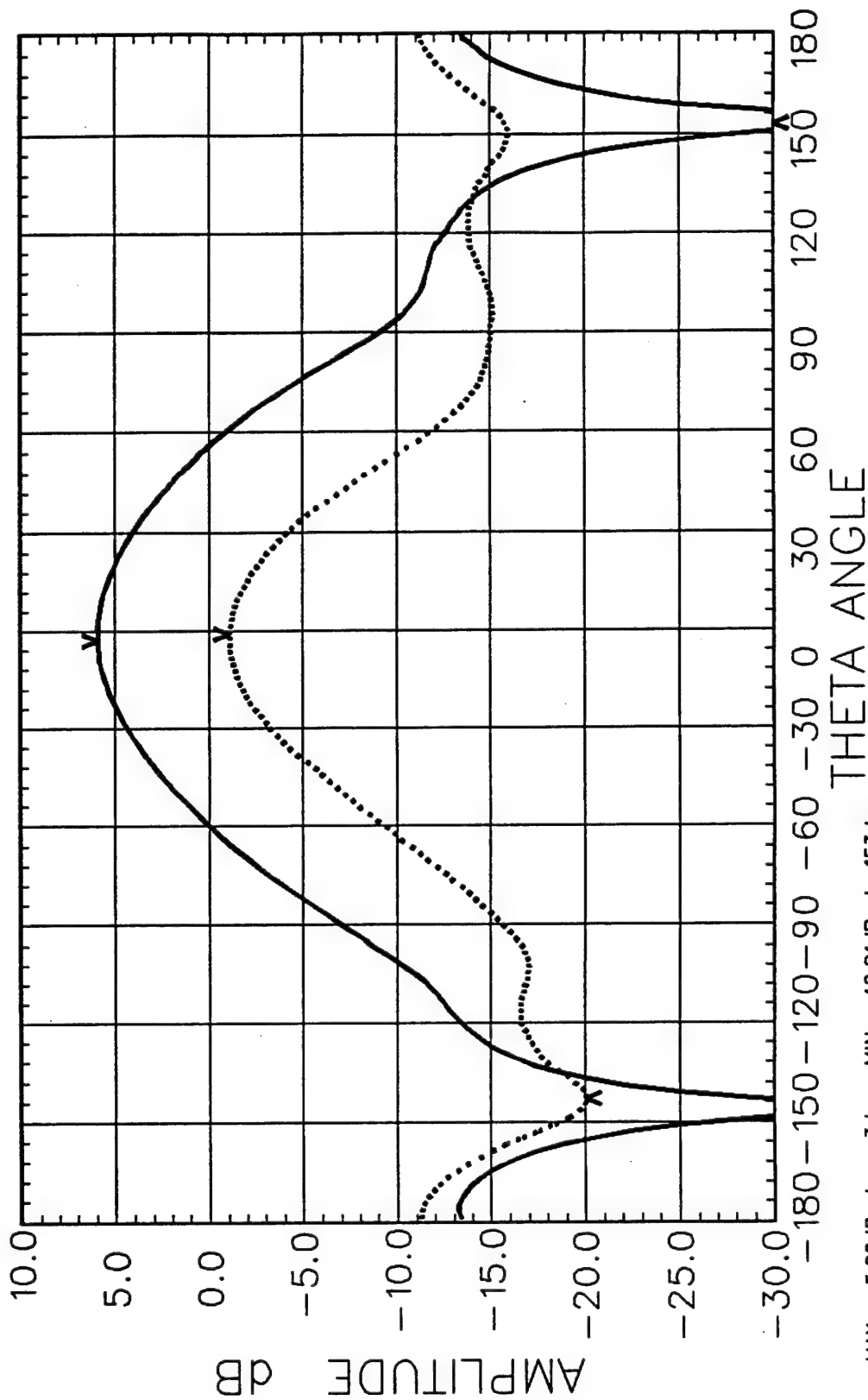
TAGGANT

BALL AEROSPACE

CP6501 HAS 15dB IF ATTEN
CP6501 HAS 15dB IF ATTEN

260MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
260MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE

— is
..... is



— MAX: 5.92dB at -3deg MIN: -42.01dB at 153deg
..... MAX: -1.09dB at -1deg MIN: -20.05dB at -14.3deg

2) REPT: 18 MAY 92
CP15M: 28 OCT 91
CP15M: 28 OCT 91

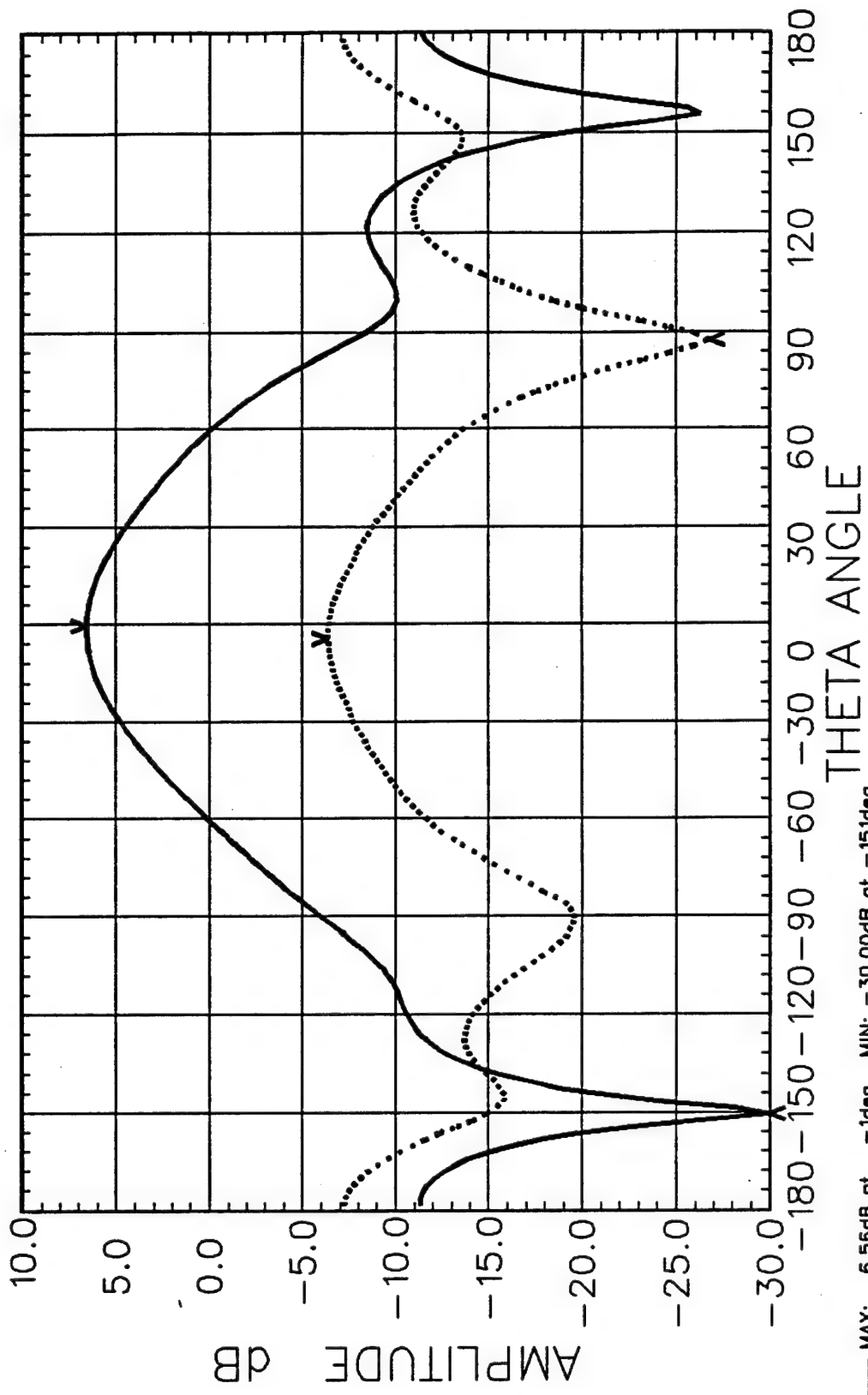
1/2"BELOW GP,3"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

— is 290MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 290MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE

CP6502 HAS 15dB IF ATTEN
CP6502 HAS 15dB IF ATTEN



— MAX: 6.56dB at -1deg MIN: -30.00dB at -151deg
..... MAX: -6.37dB at -5deg MIN: -26.80dB at 87deg

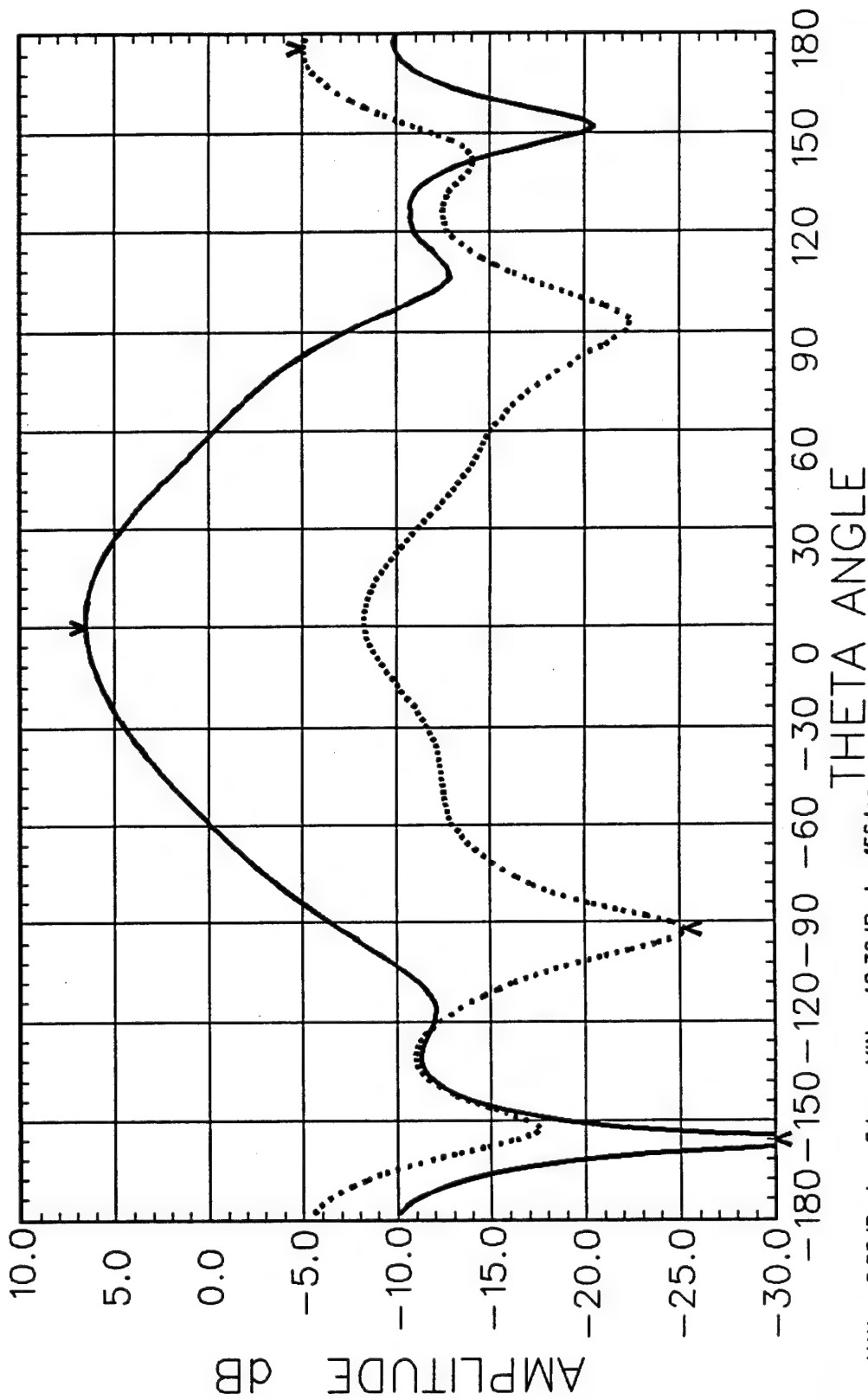
1/2"BELOW GP,3"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6503 HAS 15dB IF ATTEN
CP6503 HAS 15dB IF ATTEN

— is 320MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 320MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



— MAX: 6.53dB at 0deg MIN: -40.39dB at -156deg
..... MAX: -5.04dB at 176deg MIN: -25.32dB at -92deg

1/2"BELOW GP,5"BORDER
18 NOV 92

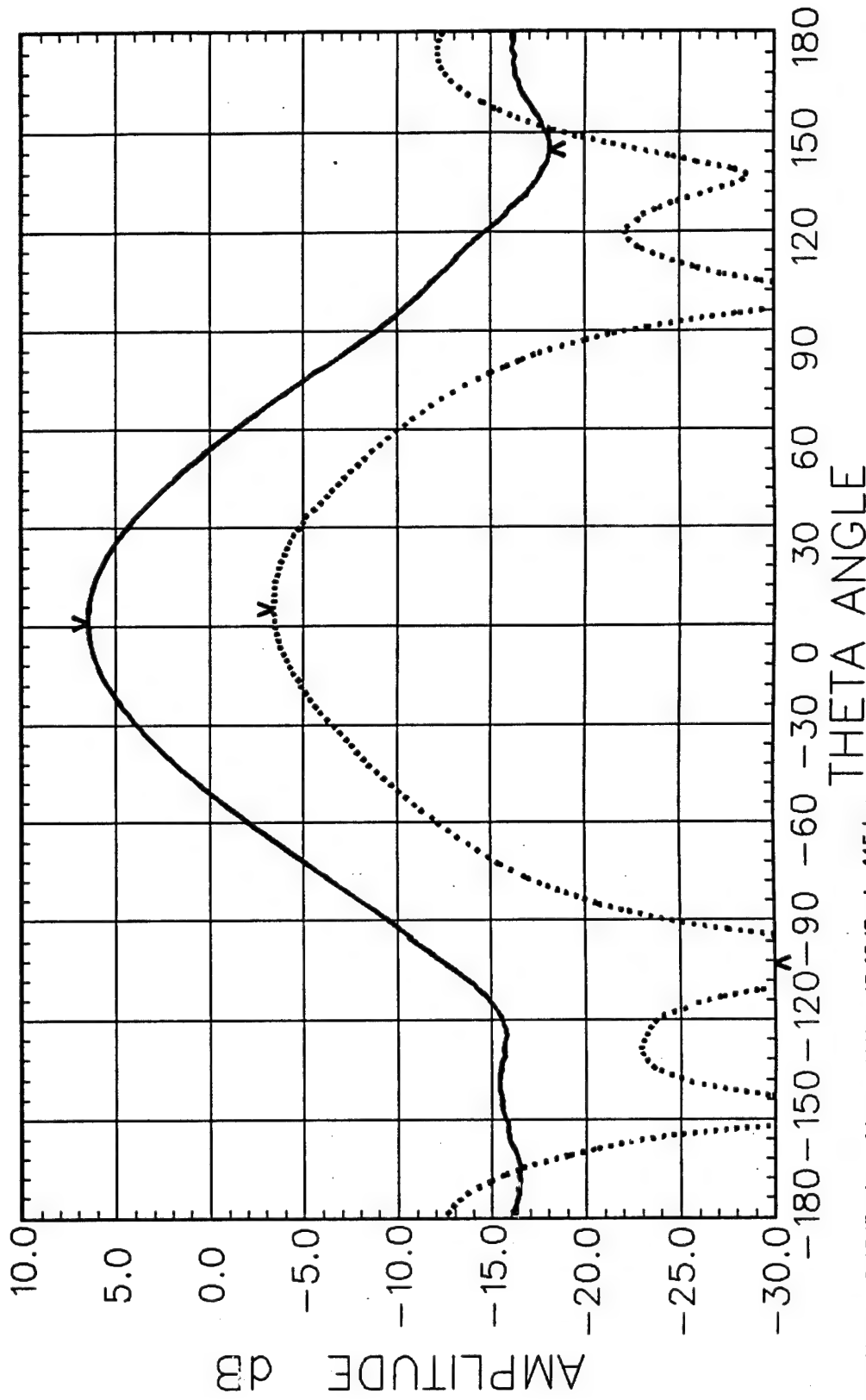
TAGGANT

BALL AEROSPACE

CP6521 HAS 15dB IF ATTEN
CP6521 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

260MHz RHCP GAIN PHI=
260MHz LHCP GAIN PHI=



MAX: 6.45dB at 1deg MIN: -18.16dB at -103deg
MAX: -3.39dB at 5deg MIN: -52.19dB at -103deg

1) REPT:18 MAY 92
2) REPT:18 MAY 92
3) REPT:18 MAY 92
4) REPT:18 MAY 92
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100) REPT:18 MAY 92

1/2"BELOW GP.5"BORDER
18 NOV 92

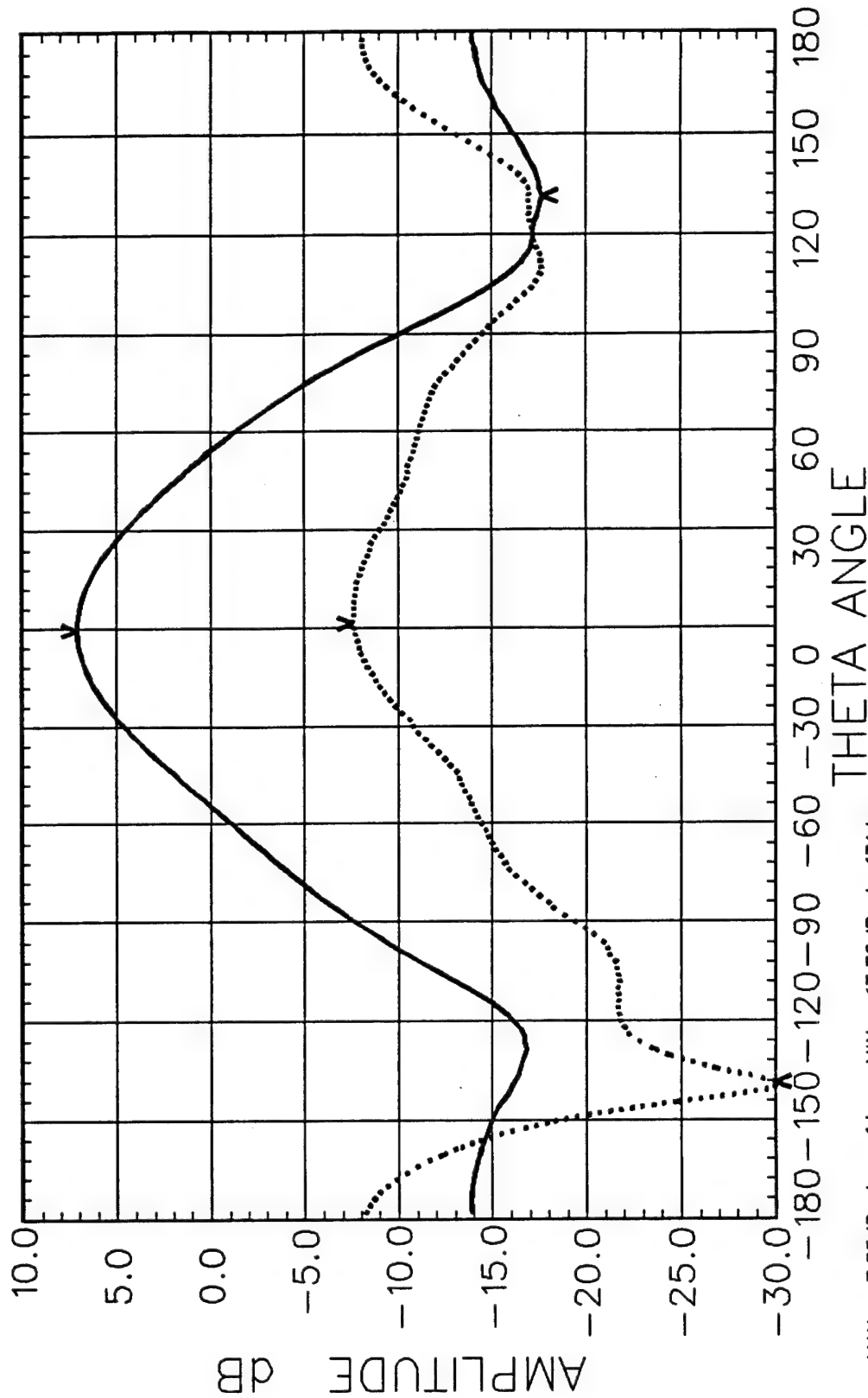
TAGGANT

BALL AEROSPACE

CP6522 HAS 15dB IF ATTEN
CP6522 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

290MHz RHCP GAIN PHI=
290MHz LHCP GAIN PHI=



MAX: 7.08dB at -1deg MIN: -17.70dB at 131deg
MAX: -7.60dB at 1deg MIN: -30.04dB at -139deg

1) RELUT:19 MAY 92
2) RELUT:28 OCT 91
3) RELUT:28 OCT 91

1/2"BELOW GP,5"BORDER
18 NOV 92

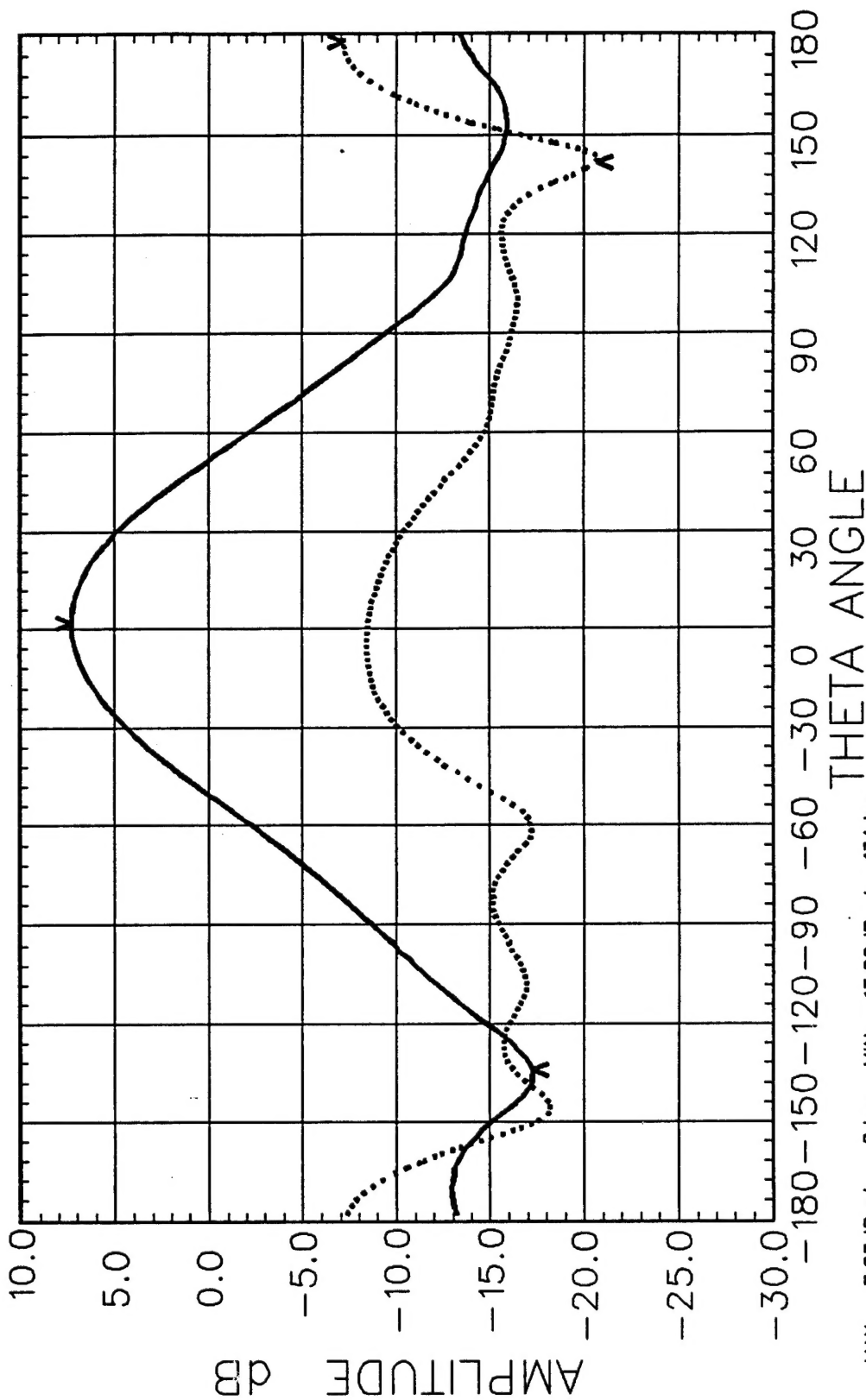
TAGGANT

BALL AEROSPACE

CP6523 HAS 15dB IF ATTEN
CP6523 HAS 15dB IF ATTEN

0deg ABSOLUTE AMPLITUDE
0deg ABSOLUTE AMPLITUDE

is 320MHz RHCP GAIN PHI=
is 320MHz LHCP GAIN PHI=



MAX: 7.28dB at 2deg MIN: -17.29dB at -13.4deg
MAX: -7.15dB at 178deg MIN: -20.72dB at 142deg

1) RPL01:19 MAY 92
2) RPL01:19 MAY 92
CP101:28 OCT 91
CP101:28 OCT 91

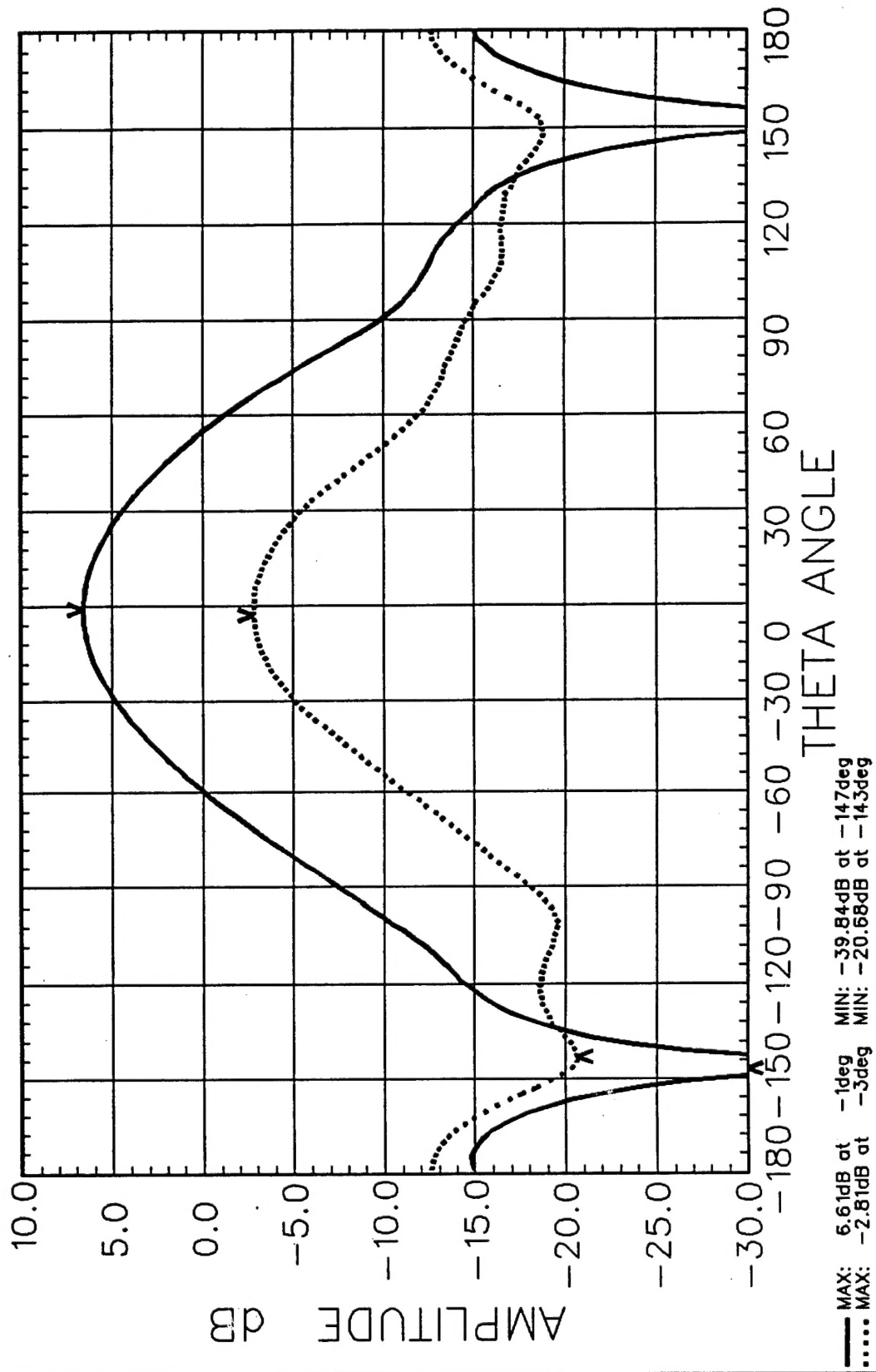
1/2"BELOW GP.5"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6541 HAS 15dB IF ATTEN
CP6541 HAS 15dB IF ATTEN

— is 260MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
..... is 260MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



2) RELOT:18 MAY 92
CP15M:28 OCT 91

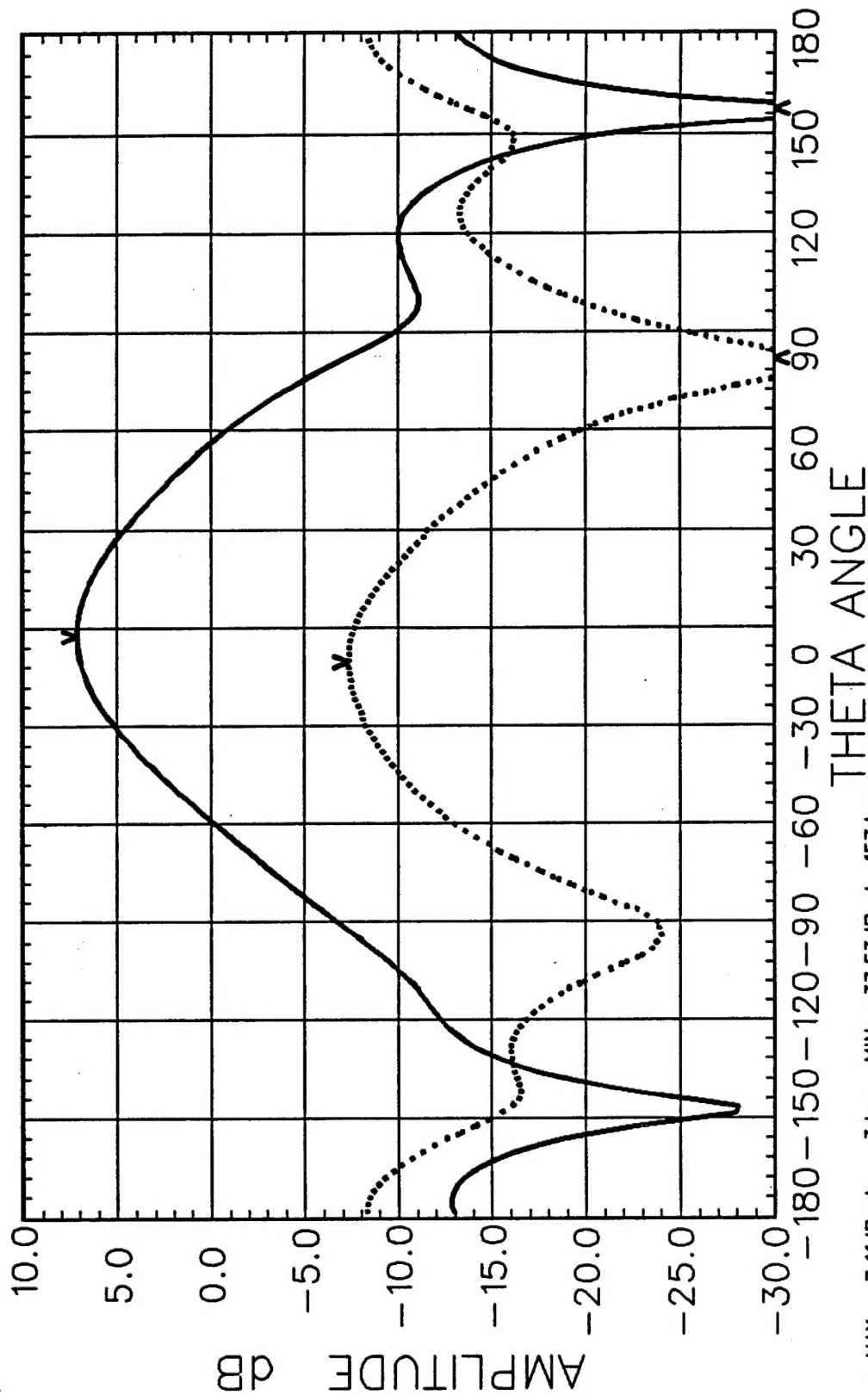
1/2"BELOW GP,5"BORDER
18 NOV 92

TAGGANT

BALL AEROSPACE

CP6542 HAS 15dB IF ATTEN
CP6542 HAS 15dB IF ATTEN

290MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
290MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE



— MAX: 7.11dB at -3deg MIN: -37.53dB at 157deg
..... MAX: -7.35dB at -11deg MIN: -32.04dB at 81deg

1/2"BELOW GP,5"BORDER
18 NOV 92

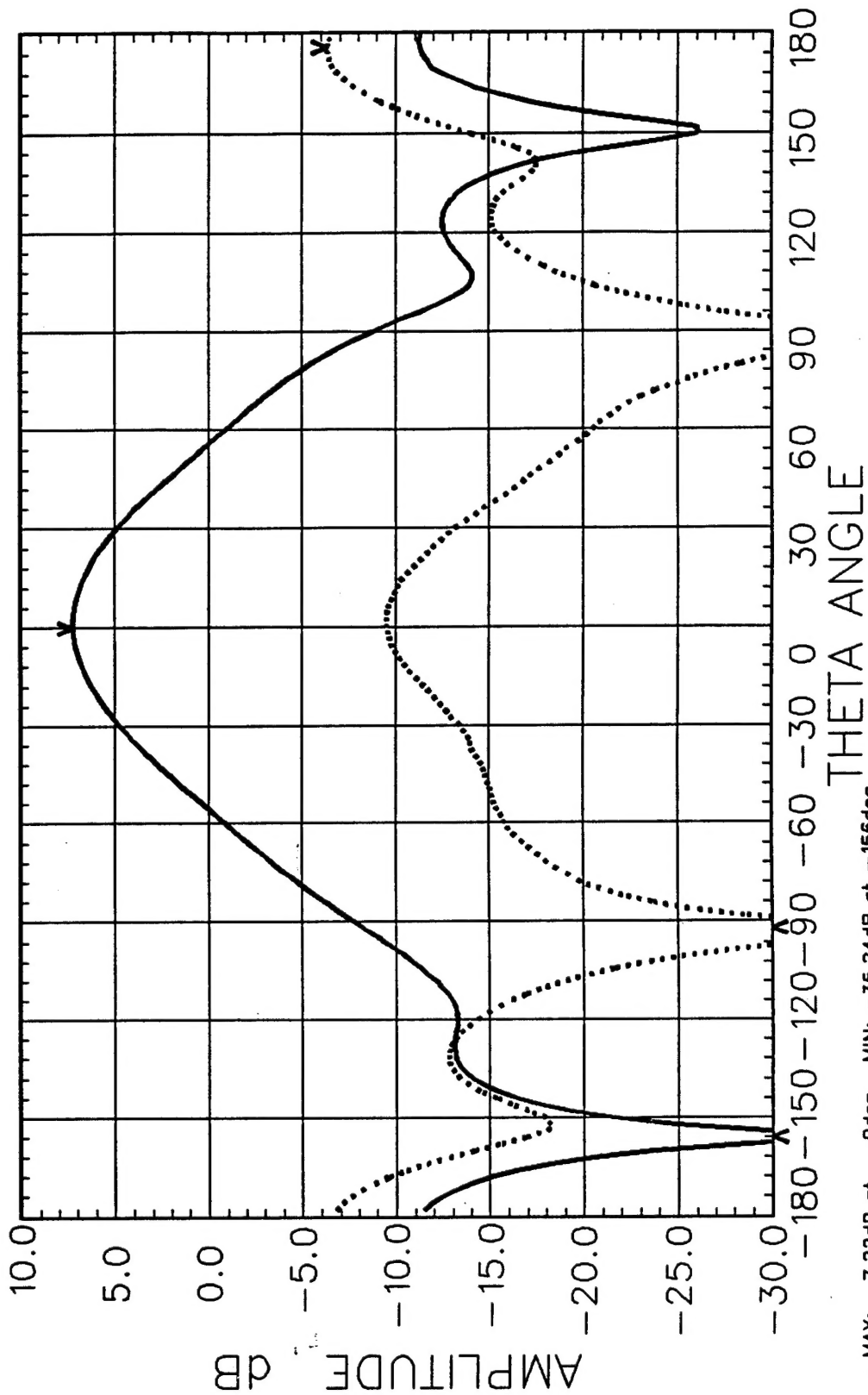
TAGGANT

BALL AEROSPACE

CP6543 HAS 15dB IF ATTEN
CP6543 HAS 15dB IF ATTEN

320MHz RHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE
320MHz LHCP GAIN PHI= 90deg ABSOLUTE AMPLITUDE

— is
..... is



— MAX: 7.22dB at 0deg MIN: -35.24dB at -156deg
..... MAX: -6.33dB at 176deg MIN: -39.72dB at -92deg